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STAR

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NOVEMBER 8, 1972

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N72-29991—N72-30988

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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INTRODUCTION

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STAR is a comprehensive abstracting and indexing journal covering current worldwide *report* literature on the science and technology of space and aeronautics. Publications abstracted in *STAR* include scientific and technical reports issued by NASA and its contractors, other U.S. Government agencies, corporations, universities, and research organizations throughout the world. Pertinent theses, translations, NASA-owned patents and patent applications, and other separate documents are also abstracted. Citations and abstracts in *STAR* are grouped in 34 subject categories, although accession numbers run in unbroken sequence through the *STAR* issues, without regard to category assignment.

Certain publications abstracted in *STAR* are given analytic treatment, with citations and abstracts of daughter items following immediately after the parent document. When the subject content of a daughter differs from that of its parent, a cross-reference citation is printed at the end of the category to which the daughter would normally have been assigned.

Five indexes are included in each issue: subject, personal author, corporate source, contract number, and report/accession number. Cumulative index volumes are published semi-annually and annually.

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IAA is available on subscription from the American Institute of Aeronautics and Astronautics. Technical Information Service, 750 Third Avenue, New York, NY 10017, at the following annual rates:

Semimonthly issues: United States and possessions, $110 postpaid; foreign countries, $125 postpaid.

Cumulated index volumes: United States and possessions, $75 postpaid; foreign countries, $90 postpaid.

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Scientific and technical reports produced by NASA and its contractors and grantees, or in conjunction with other Government agencies, and other selected documents released by NASA are identified by an asterisk (*) following the accession numbers (e.g., N72-10748*). Prior to their announcement in *STAR*, these NASA publications are assigned a specific NASA report number, which is shown on the last line of the *STAR* citation. The nature of NASA publications is specified by the report number series, identified by a prefix to the report number: TR-R, TN-D, TM-X, TT-F, CR, or SP. These series refer respectively to NASA Technical Reports, which contain significant and complete contributions to scientific and technical knowledge; Technical Notes, reports of similar quality but lesser scope; Technical Memorandums, reports containing preliminary data or of specialized utility; Technical Translations, information published in a foreign language and considered to merit NASA distribution in English; Contractor Reports, information generated under NASA-sponsored contracts, grants, or interagency agreements; and Special Publications, which include conference proceedings, monographs, data compilations, sourcebooks, special bibliographies, and other publications derived from or of value to NASA activities. Reports in these series that are printed by NASA are often referred to as "low-numbered" or "low series" publications, because the report number is always below 50,000 (8,000 for Technical Translations). Some TM-X and CR reports are numbered above 50,000. These, and TT-F translations above 8,000, are referred to as "high-numbered" or "high series" publications, and are generally available only in microfiche[1] or facsimile reproductions.

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depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Technical Information Center.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set. The first two volumes of this Thesaurus, consisting of the alphabetical listing of subject terms (A–Z), have been superseded by the following single-volume publication: *NASA Thesaurus Alphabetical Update* (September 1971) (NASA SP-7040), available from NTIS for $6.00. (Volume III of the Preliminary Edition consists of the following ancillary aids to vocabulary selection: hierarchical display of index terms, category term listing, permuted index, and a listing of postable terms only.)

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Federal Republic of Germany

Volume 10 Number 21 / November 8, 1972

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

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05 Biotechnology **2790**
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

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10 Electronics **2804**
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

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Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

12 Fluid Mechanics **2810**
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

13 Geophysics **2816**
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

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18 Materials, Nonmetallic **2840**
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

19 Mathematics **2844**
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

20 Meteorology **2847**
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

21 Navigation **2851**
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

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28 Propulsion Systems **2878**
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29 Space Radiation **2880**
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

30 Space Sciences **2881**
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

31 Space Vehicles **2888**
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

32 Structural Mechanics **2897**
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Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

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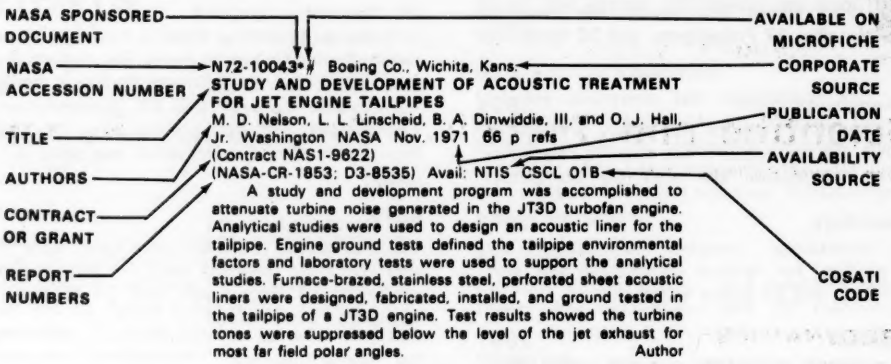
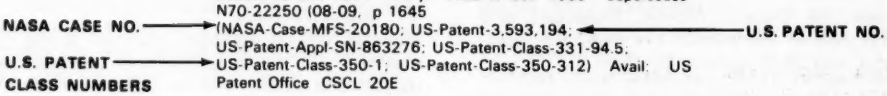


N72-10043*# Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B

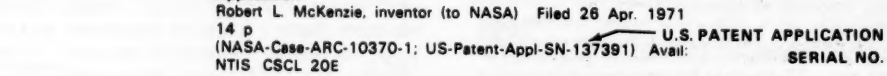
A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

PATENT CITATION



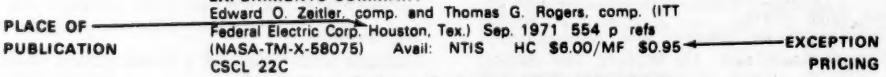
N72-12440* Auburn Research Foundation, Inc., Ala.
LASER COOLANT AND ULTRAVIOLET FILTER Patent
John R. Rasquin and Fred R. McDevitt, inventors (to NASA)
Issued 13 Jul. 1971 14 p Filed 2 Oct. 1969 Supersedes N70-22250 (08-09, p 1645
(NASA-Case-MFS-20180; US-Patent-3,593,194; US-Patent-Appl-SN-863276; US-Patent-Class-331-94.5; US-Patent-Class-350-1; US-Patent-Class-350-312) Avail: US Patent Office CSCL 20E

PATENT APPLICATION CITATION



N72-10432*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIATOMIC INFRARED GASDYNAMIC LASER Patent Application
Robert L. McKenzie, inventor (to NASA) Filed 26 Apr. 1971 14 p
(NASA-Case-ARC-10370-1; US-Patent-Appl-SN-137391) Avail: NTIS CSCL 20E

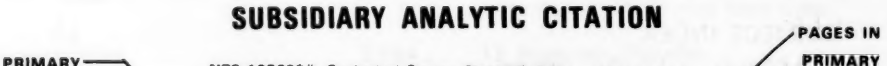
PRIMARY ANALYTIC CITATION AND ABSTRACT



N72-10856*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY
Edward O. Zeitler, comp. and Thomas G. Rogers, comp. (ITT Federal Electric Corp. Houston, Tex.) Sep. 1971 554 p refs
(NASA-TM-X-58075) Avail: NTIS HC $6.00/MF $0.95 CSCL 22C

Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

SUBSIDIARY ANALYTIC CITATION


PRIMARY ANALYTIC ACCESSION AND LOCATION OF FULL CITATION AND ABSTRACT
PAGES IN PRIMARY REPORT
PRICE OF PRIMARY REPORT

N72-10862*# Geological Survey, Flagstaff, Ariz.
EXPERIMENT S029: EARTH-MOON LIBRATION REGIONS PHOTOGRAPHY
Elliott C. Morris *In* NASA. Manned Spacecraft Center The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 71-75
(See N72-10856 01-30)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

VOLUME 10 NUMBER 21 / NOVEMBER 8, 1972

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N72-29991*+ National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 19, JUNE 1972
Jun. 1972 132 p refs
(NASA-SP-7037(19)) Avail: NTIS HC $3.00 CSCL 01A

This special bibliography lists 432 reports, articles, and other documents introduced into the NASA scientific and technical information system in May 1972. Author

N72-29992# Aeronautical Research Committee, Bangalore (India).
CONICALLY CAMBERED TRIANGULAR WINGS OPTIMISED FOR LEAST DRAG WITHOUT LEADING EDGE SUCTION
V. S. Holla, T. N. Krishnaswamy, and S. M. Ramachandra Oct. 1971 30 p refs
(ARC-TR-2) Avail: NTIS HC $3.50

A method of designing optimized conically cambered triangular wings with subsonic leading edges and supersonic trailing edges, is given using load distributions vanishing at the leading edge. The characteristics of these wings are compared with plane triangular wing (with suction) which has the minimum lift dependent drag. Lagrange's method is used in the optimization procedure. In general, it is seen that optimized wing shapes obtained from the basic load and twist distribution used in the present case are of practical use. Author

N72-29993*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL STUDY OF EFFECT OF CASING TREATMENT ON PERFORMANCE OF A MULTISTAGE COMPRESSOR
Roger W. Snyder and Robert J. Blade Washington Aug. 1972 26 p refs
(NASA-TN-D-6917; E-6920) Avail: NTIS HC $3.00 CSCL 20D

The simulation was based on individual stage pressure and efficiency maps. These maps were modified to account for casing treatment effects on the individual stage characteristics. The individual stage maps effects on overall compressor performance were observed. The results show that to improve the performance of the compressor in its normal operating range, casing treatment of the rear stages is required. Author

N72-29994*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF CONFIGURATION MODIFICATION ON THE HYPERSONIC AERODYNAMIC CHARACTERISTICS OF A BLENDED DELTA WING-BODY ENTRY VEHICLE
James P. Arrington and George C. Ashby, Jr. Washington Sep. 1972 58 p refs
(NASA-TM-X-2611; L-8419) Avail: NTIS HC $3.00 CSCL 01A

The longitudinal, lateral, and directional aerodynamic characteristics of a delta-wing configuration were obtained experimentally at Mach 20 in helium with Reynolds numbers, based on model length, of 1.5 million and 2.9 million and at a Mach number of 6 in air with a Reynolds number, based on model length, of 4.8 million. The angles of attack varied from 0 deg to 55 deg for two sideslip angles. The effects of the addition of dorsal fins, the removal of wing tip fins, an increase in elevon span, and changes in elevon hinge-line sweep angle are discussed. The unmodified vehicle had a maximum lift-drag ratio of 2.1 at Mach 19 and of 2.4 at Mach 6 with about the same lateral and directional stability level at both Mach numbers. As the Mach number increased from 6 to 20, the longitudinal center of pressure moved forward and more positive elevon deflection was therefore required to maintain a given trim angle. The removal of wing tip fins increased the maximum lift-drag ratio and had a negligible effect on longitudinal stability, but caused directional instability that was not corrected by the dorsal fins examined. The shape of the wing and elevon hinge-line sweep had a large influence on the induced yawing moment due to roll control. Author

N72-29995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A TWO-STAGED SPACE-SHUTTLE MODEL HAVING A DELTA-WING ORBITER MATED ATOP A WINGED BOOSTER
Ernald B. Graves Washington Sep. 1972 260 p
(NASA-TM-X-2569; L-8300) Avail: NTIS HC $3.00 CSCL 01A

An investigation has been conducted in the Langley Unitary Plan wind tunnel to determine the static aerodynamic characteristics of a two-staged space-shuttle system consisting of a delta-wing orbiter mated atop a winged booster. The tests were performed at Mach numbers from 2.30 to 4.60 at a Reynolds number of one million per foot. Author

N72-29996# Joint Publications Research Service, Arlington, Va.
SOLUTION OF THE PROBLEM OF AN AIRFOIL OF ARBITRARY PLAN CONFIGURATION MOVING NEAR A GROUND-EFFECT SURFACE
S. D. Yermolenko and A. V. Rovnykh 28 Jul. 1972 15 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), no. 1, 1971 p 5-14

(JPRS-56629) Avail: NTIS HC $3.00

The problem of an airfoil of arbitrary plan configuration moving near a ground-effect surface is solved employing a non-linear method. The results of computing aerodynamic characteristics of airfoils of varying plan configurations with experimental data pertaining to thin plates are compared.

Author

N72-29997# Air Force Armament Lab., Eglin AFB, Fla.

A METHOD FOR ELIMINATING THE MAGNUS INSTABILITY OF A FINNED MISSILE M.S. Thesis

Edward S. Sears Nov. 1971 66 p refs

(AD-742229; AFATL-TR-71-149) Avail: NTIS CSCL 19/1

Subsonic one-degree-of-freedom and three-degrees-of-freedom wind tunnel tests were performed to determine whether N-vanes attached to a spinning, statically stable missile would eliminate the Magnus instabilities which can occur at high spin rates. The clean configuration missile that was tested had a large precession limit cycle of about 35 degrees amplitude. With N-vanes at -15 degrees, it was possible to eliminate the precession limit cycle. With the N-vanes at -15 degrees, the precession limit cycle was eliminated, and a nutation limit cycle of 25 dzgrees was created. The motion of the missile with and without N-vanes was photographed with a high speed camera. The angular data obtained were fit using the WOBBLE computer program to obtain the coefficients of pitching moment, pitch damping moment, and Magnus moment. Author (GRA)

N72-29998# New York Univ., N.Y. School of Engineering and Science.

AERODYNAMIC STUDIES OF WING BODY Final Report

Antonio Ferri and Lu Ting Feb. 1972 12 p refs

(Grant AF-AFOSR-1062-67; AF Proj. 9782)

(AD-741917; AFOSR-72-1020TR) Avail: NTIS CSCL 20/4

The main objectives of the research were to carry out the theoretical analysis of the flow field near a wing body configuration, to develop the far field solutions and to study their interference effects on another airplane. Analyses have been carried out and definite results are obtained in the following topics: (1) the motion and decay of vortex lines, (2) the connection of near field data to far field solution, (3) turbulent flow and boundary layer separation, and (4) the aerodynamic effects on an airplane by an incident shock. Author (GRA)

N72-30869* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IN-FLIGHT AEROACOUSTIC ENVIRONMENTS ON PROSPECTIVE SPACE SHUTTLE VEHICLES

Jules B. Dods, Jr. and Richard D. Hanly *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 71-96 refs (For availability see N72-30865 21-31)

CSCL 22C

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-29999*# Clemson Univ., S.C.

EVALUATION OF MINIMUM VARIANCE ESTIMATORS FOR SIGNAL DERIVATIVES IN REAL NOISE ENVIRONMENTS

R. W. Snelsire [1972] 37 p refs

(Grant NGR-41-001-024)

(NASA-CR-112146) Avail: NTIS HC $4.00 CSCL 01B

A digital filter has been developed to optimally estimate the rate of descent of an aircraft to permit all-weather operation. The filter was evaluated using recorded rate of descent information from flight instruments. The evaluation showed the filter to be superior to other systems especially when operated in turbulent air. Author

N72-30000*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.

FLIGHT VELOCITY INFLUENCE ON JET NOISE OF CONICAL EJECTOR, ANNULAR PLUG AND SEGMENTED SUPPRESSOR NOZZLES

J. F. Brausch Aug. 1972 268 p refs

(Contract NAS3-15773)

(NASA-CR-120961) Avail: NTIS HC $15.50 CSCL 01B

An F106 aircraft with a J85-13 engine was used for static and flight acoustic and aerodynamic tests of a conical ejector, an unsuppressed annular plug, and three segmented suppressor nozzles. Static 100 ft. arc data, corrected for influences other than jet noise, were extrapolated to a 300 ft. sideline for comparison to 300 ft. altitude flyover data at M = 0.4. Data at engine speeds of 80 to 100% (max dry) static and 88 to 100% flight are presented. Flight velocity influence on noise is shown on peak OASPL and PNL, PNL directivity, EPNL and chosen spectra. Peak OASPL and PNL plus EPNL suppression levels are included showing slightly lower flight than static peak PNL suppression but greater EPNL than peak PNL suppression. Aerodynamic performance was as anticipated and closely matched model work for the 32-spoke nozzle. Author

N72-30001*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN ANALYSIS OF THE TAKEOFF AND LANDING PERFORMANCE OF A JET-POWERED STOL AUGMENTOR WING DESIGN

Susan E. Post, Bruno J. Gambucci, and Curt A. Holzhauser Aug. 1972 63 p refs

(NASA-TM-X-62176) Avail: NTIS HC $5.25 CSCL 01B

A preliminary study of the takeoff and landing performance characteristics of a swept wing airplane with augmented jet flap, designed for STOL operation and low noise is presented. The study is based on aerodynamic data from wind tunnel tests of a large-scale swept augmentor wing model, scaled up to a 48,000 pound airplane. Engine characteristics are based on a turbo fan with a fan pressure ratio of 2.5 delivering the major portion of the thrust to the augmentor flap. A description of the overall airplane configuration, the propulsion system, and the use of the aerodynamics is presented. To assess the STOL performance of the airplane, takeoff and landing distances and flight path capabilities were computed at various flap deflections and thrust levels. After evaluating these results in terms of desired STOL performance with required margins, basic takeoff and landing configurations were chosen. Author

N72-30002*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

ANALYSIS OF AN ELECTROHYDRAULIC AIRCRAFT CONTROL SURFACE SERVO AND COMPARISON WITH TEST RESULTS

John W. Edwards Washington Aug. 1972 73 p refs

(NASA-TN-D-6928; H-629) Avail: NTIS HC $3.00 CSCL 01B

An analysis of an electrohydraulic aircraft control-surface system is made in which the system is modeled as a lumped, two-mass, spring-coupled system controlled by a servo valve. Both linear and nonlinear models are developed, and the effects of hinge-moment loading are included. Transfer functions of the system and approximate literal factors of the transfer functions for several cases are presented. The damping action of dynamic pressure feedback is analyzed. Comparisons of the model responses with results from tests made on a highly resonant rudder control-surface servo indicate the adequacy of the model. The effects of variations in hinge-moment loading are illustrated.

Author

N72-30003*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FLAP-LAG STABILITY OF HINGELESS HELICOPTER ROTOR BLADES

Robert A. Ormiston and William G. Bousman Aug. 1972 28 p refs Sponsored in part by Army Air Mobility R and D Lab.

(NASA-TM-X-62179) Avail: NTIS HC $3.50 CSCL 01B

The stability of hingeless rotor blade oscillations in hover is examined theoretically using a simplified centrally-hinged, spring-restrained, rigid blade to approximate the deflections of actual elastic blades. The aerodynamic and inertial coupling between the flap and lead-lag degrees of freedom is primarily responsible for instability, however elastic coupling and kinematic pitch-lag coupling both exert a powerful influence on hingeless rotor blade stability. Experimental results obtained from a two-bladed 1.81m diameter model rotor designed for minimum elastic coupling have confirmed the results of linear theory. For this model configuration rotor blade stall at high pitch angles was found to counteract the destabilizing flap-lag coupling and increase the damping of lead-lag oscillations. It was possible to account for this effect with the theory by using drag data for stalled airfoils. Author

N72-30004*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT MEASUREMENTS OF BUFFET CHARACTERISTICS OF THE F-104 AIRPLANE FOR SELECTED WING-FLAP DEFLECTIONS

Edward L. Friend and Walter J. Sefic Washington Aug. 1972 48 p refs

(NASA-TN-D-6943; H-666) Avail: NTIS HC $3.00 CSCL 01B

A flight program was conducted on the F-104 airplane to investigate the effects of moderate deflections of wing leading- and trailing-edge flaps on the buffet characteristics at subsonic and transonic Mach numbers. Selected deflections of the wing leadingand trailing-edge flaps, individually and in combination, were used to assess buffet onset, intensity, and frequency; lift curves; and wing-rock characteristics for each configuration. Increased deflection of the trailing-edge flap delayed the buffet onset and buffet intensity rise to a significantly higher airplane normal-force coefficient. Deflection of the leading-edge flap produced some delay in buffet onset and the resulting intensity rise at low subsonic speeds. Increased deflection of the trailing-edge flap provided appreciable lift increments in the angle-of-attack range covered, whereas the leading-edge flap provided lift increments only at high angles-of-attack. The pilots appreciated the increased maneuvering envelope provided by the flaps because of the improved turn capability. Author

N72-30005# National Aviation Facilities Experimental Center, Atlantic City, N.J.

RELATIONSHIP BETWEEN THE SAE SMOKE NUMBER AND JET AIRCRAFT SMOKE VISIBILITY

Gerald R. Slusher Dec. 1971 24 p refs

(FAA Proj. 502-306-02X)

(FAA-RD-71-23; FAA-NA-71-25) Avail: NTIS HC $3.25

A method was developed using the Society of Automotive Engineers (SAE) smoke numbers for calculating the exhaust smoke transmission for turbine engines, number of plume paths, and viewing angles. Criteria were developed relating the SAE smoked number to engine airflow and thus to engine size for conditions of visible and invisible smoke. Transmission of multiple plumes was calculated and presented. Author

N72-30006# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT PRELIMINARY REPORT: AMERICAN AIRLINES, INCORPORATED DC-10-10, N103AA 8 MILES SOUTH OF THE WINDSOR, ONTARIO, CANADA, VORTAC AT 11750 FEET, 12 JUNE 1972

22 Aug. 1972 8 p ref

(SB-72-69/878A) Avail: NTIS HC $3.00

An inflight emergency caused by rapid decompression following accidental opening of a cargo door is discussed. The aircraft was a DC-10 in flight near Windsor, Ontario, Canada on 12 June 1972. Actions taken by the pilot following the emergency are discussed and causes for injury to the passengers following the safe landing are examined. The report is preliminary in nature pending final decision of the National Transportation Safety Board. P.N.F.

N72-30007*# New York Univ., N.Y.

EXPERIMENTAL VERIFICATION OF LOW SONIC BOOM CONFIGURATION

Antonio Ferri, Huai-Chu Wang, and Hans Sorensen (Aeronautical Inst. of Sweden) Washington NASA Jun. 1972 111 p refs (Grant NGL-33-016-119)

(NASA-CR-2070; NYU-AA-71-19) Avail: NTIS HC $3.00 CSCL 01B

A configuration designed to produce near field signature has been tested at M = 2.71 and the results are analyzed, by taking in account three-dimensional and second order effects. The configuration has an equivalent total area distribution that corresponds to an airplane flying at 60,000 ft. having a weight of 460,000 lbs, and 300 ft. length. A maximum overpressure of 0.95 lb/square foot has been obtained experimentally. The experimental results agree well with the analysis. The investigation indicates that the three-dimensional effects are very important when the measurements in wind tunnels are taken at small distances from the airplane. Author

N72-30008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION AT LOW SPEEDS OF A MODEL OF THE KESTREL (XV-6A) VECTORED-TRUST V/STOL AIRPLANE

Richard J. Margason, Raymond D. Vogler, and Matthew M. Winston Washington Jul. 1972 177 p refs

(NASA-TN-D-6826; L-8193) Avail: NTIS HC $3.00 CSCL 01B

Longitudinal and lateral stability data were obtained with the model out of and in ground effect over a moving ground plane for a range of model angles of attack and sideslip at various thrust coefficients. These data were taken primarily at thrust coefficients which simulate transition speeds on the airplane between hover and 200 knots. Some data, however, represent the effect of thrust deflection at speeds up to 350 knots. Also presented are the effects of control-surface deflections and interference between the jets and free stream. Author

N72-30009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYTICAL STUDY OF AIRPLANE-AUTOPILOT RESPONSE TO ATMOSPHERIC TURBULENCE

Waldo I. Oehman Washington Sep. 1972 43 p refs

(NASA-TN-D-6869; L-8140) Avail: NTIS HC $3.00 CSCL 01B

An analytical study has shown that, with proper selection of feedback gains, an automatic control system can reduce excursions in altitude of a jet transport flying in turbulence without increasing structural loads. The control system uses feedback of attitude-angle and pitch-rate signals to the elevator and uses feedback of altitude and altitude-rate signals to the throttle.

Author

N72-30010*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF AN IN-FLIGHT THRUST REVERSER ON THE STABILITY AND CONTROL CHARACTERISTICS OF A SINGLE-ENGINE FIGHTER AIRPLANE MODEL

Charles E. Mercer and Donald L. Maiden Washington Sep. 1972 237 p refs

(NASA-TN-D-6886; L-8395) Avail: NTIS HC $3.00 CSCL 01B

The changes in thrust minus drag performance as well as longitudinal and directional stability and control characteristics of a single-engine jet aircraft attributable to an in-flight thrust

reverser of the blocker-deflector door type were investigated in a 16-foot transonic wind tunnel. The longitudinal and directional stability data are presented. Test conditions simulated landing approach conditions as well as high speed maneuvering such as may be required for combat or steep descent from high altitude. Author

N72-30011*# Tracor, Inc., Austin, Tex.
COMMUNITY REACTION TO AIRCRAFT NOISE AROUND SMALLER CITY AIRPORTS
William K. Conner and Harrold P. Patterson Aug. 1972 187 p refs
(Contract NAS1-10216)
(NASA-CR-2104) Avail: NTIS HC $3.00 CSCL 01B

The results are presented of a study of community reaction to jet aircraft noise in the vicinity of airports in Chattanooga, Tennessee, and Reno, Nevada. These cities were surveyed in order to obtain data for comparison with that obtained in larger cities during a previous study. (The cities studied earlier were Boston, Chicago, Dallas, Denver, Los Angeles, Miami, and New York.) The purpose of the present effort was to observe the relative reaction under conditions of lower noise exposure and in less highly urbanized areas, and to test the previously developed predictive equation for annoyance under such circumstances. In Chattanooga and Reno a total of 1960 personal interviews based upon questionnaires were obtained. Aircraft noise measurements were made concurrently and aircraft operations logs were maintained for several weeks in each city to permit computation of noise exposures. The survey respondents were chosen randomly from various exposure zones. Author

N72-30012# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: PAN AMERICAN WORLD AIRWAYS, INCORPORATED, BOEING 747, N747PA, FLIGHT 845, SAN FRANCISCO, CALIFORNIA, 30 JULY 1971
24 May 1972 58 p
(NTSB-AAR-72-17) Avail: NTIS

An aircraft accident involving a Boeing 747 which struck an approach light support during takeoff from San Francisco International Airport is discussed. The aircraft completed an emergency landing and minor injuries to several passengers were incurred. The cause of the accident was determined as pilot error in using incorrect takeoff reference speeds. Author

N72-30013*# Bell Helicopter Co., Fort Worth, Tex.
LARGE SCALE WIND TUNNEL INVESTIGATION OF A FOLDING TILT ROTOR Final Report
May 1972 195 p refs
(Contract NAS2-5461)
(NASA-CR-114464; D272-099-002) Avail: NTIS HC $11.75 CSCL 01B

A twenty-five foot diameter folding tilt rotor was tested in a large scale wind tunnel to determine its aerodynamic characteristics in unfolded, partially folded, and fully folded configurations. During the tests, the rotor completed over forty start/stop sequences. After completing the sequences in a stepwise manner, smooth start/stop transitions were made in approximately two seconds. Wind tunnel speeds up through seventy-five knots were used, at which point the rotor mast angle was increased to four degrees, corresponding to a maneuver condition of one and one-half g. Author

N72-30014# Committee on Commerce (U. S. Senate).
NOISE CONTROL ACT OF 1971 AND AMENDMENTS, PART 1
Washington GPO 1971 626 p refs Hearings on S. 1016 and S. 1566 before Comm. on Com., 92d Congr., 2d Sess., 28, 30 Jun. and 26 Jul. 1971
Avail: Subcomm. on the Environment.

The hearings concerning noise pollution and the Noise Control Act are reported. The comments from the following agencies are included: Department of Interior, Department of State, Comptroller General, Department of Agriculture, Civil Aeronautics Board, National Science Foundation, EPA, and NASA. Additional articles, letters, and statements concerning effects of noise, and sound rating of outdoor equipment are included. F.O.S.

N72-30015# British Aircraft Corp., Weybridge (England). Commercial Aircraft Div.
THE CORROSION PROPERTIES OF AIRFRAME CONTAMINANTS
R. Kohler and J. Scott London Min. of Defence Dec. 1971 35 p refs
(Contract KS/1/0692/C.B.43(a)2)
(D-Mat-179) Avail: NTIS HC $3.75

The analysis and corrosion testing of a series of fluids collected from the bilge areas of aircraft are described in an attempt to relate the fluids to airframe corrosion. Assessments were also made of the influence of stress, reduced oxygen levels, microbiological action and general environment when relating the corrosion behavior. ESRO

N72-30016# Bunker-Ramo Corp., Westlake Village, Calif.
CONTROL OF AVIONIC SUBSYSTEMS: THE CREW STATION MANAGEMENT PROBLEM
Richard W. Moss, John M. Reising, and William F. Swartz Wright-Patterson AFB, Ohio AFFDL 15 Mar. 1972 26 p ref
(Contract F33615-69-C-1716; AF Proj. 6190)
(AD-741945; AFFDL-TR-72-25) Avail: NTIS CSCL 01/3

The complexity of the piloting task of controlling on-board avionic subsystems is rapidly getting to the point where mission effectiveness is being degraded. The origin of this problem is evidenced by examining the trend over the past years to increasing numbers of controls and displays in the cockpit. A model is employed to analyze, in an operational context, the control tasks performed by the pilot in terms of mode annunciation, mode selection and fault warning. The conclusion reached is that the proliferation of control/display devices in the cockpit must be reversed if the pilot is to be exploited as the lead element in an advanced command, control and communications network. Author (GRA)

N72-30017# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
THE STUDY OF DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL Final Scientific Report, 1 Jan. 1969 - 31 Dec. 1971
E. B. Lee 8 May 1972 28 p refs
(Grant AF-AFOSR-1502-68; AF Proj. 9769)
(AD-741920; AFOSR-72-1032TR) Avail: NTIS CSCL 01/3

Control and modeling of systems with distributive parameters and time delays have been considered. Various theoretical topics related to the modeling and control for the distributive system were studied in detail. Among the topic areas considered are modeling and computer simulation for systems with time delays, quadratic optimization and feedback controllers for linear time delay systems, and stability, controllability and observability for generalized dynamical systems. The goal has been to involve techniques which can be readily used in the design of controllers to reduce structural loading during wind gusts and in design of controllers which can be used in configuring the vehicle to reduce appendage size and weight while maintaining satisfactory aircraft handling characteristics. Author (GRA)

N72-30018# American Airlines, Inc., New York.
AIR VIEW OF STOL SYSTEM REQUIREMENTS
Feb. 1972 172 p Sponsored by DOT
(AD-742463; AAL-ER/D-56; DOT-OS-10075) Avail: NTIS CSCL 13/2

Conventional air and rail systems are incapable of providing needed short-haul service for the increased capacity requirements

of the near future. Some improvements can be made but a new, integrated short-haul transportation system may be needed to supplement the present system. The complexity and magnitude of the problem require significant leadership and funding by the Federal Government. The airlines: areas of concern include the aircraft, STOLports, ATC, marketing, safety, economics, and acceptance by passengers and STOLport neighbors. This paper addresses reduced takeoff and landing (RTOL), propeller STOL transport (PST), jet STOL transport (JST), ATC, STOLport siting, route analysis, certification and safety, airline service requirements, economics, Metroflight demonstration need, STOLport acceptance, public demand stimulation and STOL development system management. Author (GRA)

N72-30019# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PARA-FOIL STEERABLE PARACHUTE, EXPLORATORY DEVELOPMENT FOR AIRDROP SYSTEM APPLICATION Final Report, Jan. 1967 - Oct. 1969
Ralph J. Speelman, III, Charles A. Babish, III, Rudi J. Berndt, James H. DeWeese, Solomon R. Metres, William R. Pinnell, and Larry L. Watson Apr. 1972 300 p refs
(AF Proj. 6065)
(AD-742294; AFFDL-TR-71-37) Avail: NTIS CSCL 01/3

An exploratory development program was conducted to demonstrate an advanced aerial delivery concept of using a Para-Foil high glide steerable parachute, mated with ground and airborne electronics homing subsystems for controlled airdrop of 500- and 2000-pound payloads. The Para-Foil is a wing made entirely of fabric and having no rigid members. It has an upper surface and a lower surface and an airfoil cross section. The leading edge is open to permit inflation due to ran air pressure. A series of wind tunnel tests with both rigid and flexible Para-Foil models was conducted to establish the effects on performance of various design parameters, to establish a performance baseline for the full scale Para-Foils, and to evaluate various reefing techniques. The Para-Foil aerodynamic turn control characteristics were evaluated through truck tow tests and a series of free flight tests. Free flight tests were also conducted to verify system performance and to evaluate automatic homing capability. Author (GRA)

N72-30020# Rochester Applied Science Associates, Inc., N.Y.
INVESTIGATION OF THE VORTEX NOISE PRODUCED BY A HELICOPTER ROTOR Final Technical Report
H. Kevin Johnson and Walter M. Katz Feb. 1972 136 p refs
(Contract DAAJ02-70-C-0023; DA Proj. 1F1-62204-AA-41)
(AD-741778; RASA-71-10; USAAMRDL-TR-72-2) Avail: NTIS CSCL 20/1

Karman-street-type vortex shedding from a lifting surface was analyzed as a source of noise from a helicopter rotor in hover and forward flight. Experimental pressure-time histories were analyzed, and high resolution spectra were developed over a frequency range of 0 to 5000 Hz using a 0.7-Hz filter. The results of the investigation indicated that vortex noise is the major source of acoustic radiation from a helicopter rotor in hover or low-speed flight and that it is concentrated in the frequency range of 200 to 500 Hz. Author (GRA)

N72-30021# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LOW MACH NUMBER WIND-TUNNEL STUDY OF AN ADVANCED MANNED INTERCEPTOR M.S. Thesis
Robert M. Foley 13 Mar. 1972 111 p refs
(AD-741745; GAM/AE/72-4) Avail: NTIS CSCL 01/3

The project involved the testing of a model of a projected advanced manned interceptor in the wind tunnel. The model was a blended-body shape designed for Mach 4 cruising flight. The test program was conducted at Mach 0.19. Basic performance parameters were recorded on IBM cards and the reduced data supplied the parameters to determine basic lift, drag, and pitching moment characteristics of the model as well as thirteen of the static stability derivatives. GRA

N72-30022# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ECOLOGICAL ASPECTS OF BIRD-AIRCRAFT STRIKE HAZARDS
Ronald J. Sobieralski Mar. 1972 33 p refs
(AF Proj. 683M)
(AD-742227; AFWL-TR-71-94) Avail: NTIS CSCL 01/5

The U. S. Air Force annually spends millions of dollars for the replacement or repair of aircraft components damaged by bird-aircraft collisions. A large percentage of these strikes occur on or in the immediate vicinity of the airfield. In order to effectively reduce the strike hazard at the airfield those features which serve to attract birds to the field must be identified and altered. The ecological survey is undertaken to identify the attractants. Selective procedures for altering the habitat can then be applied to reduce the problem without unnecessary destruction of the environment or avifauna in the area. The survey procedures established can be used by individual bases to obtain the information necessary for the application of selective corrective action. Willing, intelligent individuals at any base could perform a survey of such limited complexity as the one proposed in the report. Once the field work has been accomplished, it is recommended that a professional be consulted as to what corrective procedures should be used to eliminate or reduce the problem. Author (GRA)

N72-30023# Army Foreign Science and Technology Center, Charlottesville, Va.
BASIC THEORIES OF AIR CUSHION VEHICLES
Yu. Yu. Benya and V. K. Dyachenko Oct. 1971 429 p refs
Transl. into ENGLISH of the publ. "Osnove Teorii Sudov na Vozdushnoy Podushke"
(AD-742425; FSTC-HT-23-496-71) Avail: NTIS CSCL 13/10

The authors have succeeded in blending general information about air cushion vehicles (background information such as history, basic features of designs, and prospects for their development by the major sea powers of the world) with detailed studies of the major hydro-aerodynamic problems encountered by design engineers (concerning theories in the areas of speed, stability, manueverability and seaworthy capabilities of these strange, new craft). The result is a combination formal-informal guide which will enthuse, as well as inform, both students and technical engineers of the shipbuilding industry. Author (GRA)

N72-30024# Goodyear Aerospace Corp., Akron, Ohio.
INVESTIGATION OF DYNAMIC BEHAVIOR OF TETHERED BALLOON SYSTEMS Final Report, 1 Jan. - 31 Jan. 1972
Jerome J. Vorachek, James W. Burbick, and George R. Doyle, Jr. Bedford, Mass. AFCRL 31 Jan. 1972 164 p refs
(Contract F19628-71-C-0091; AF Proj. 7659)
(AD-740723; GER-15497; AFCRL-72-0113) Avail: NTIS CSCL 01/3

An analytical investigation of the dynamic behavior of tethered balloons was conducted. This report covers definition of tethered balloon systems and a study of stability characteristics and dynamic response to wind gusts of tethered balloon systems. The major tether construction utilizes prestretched polyester filaments. Three design altitudes, 5,000, 10,000 and 20,000 feet, are considered. The model for the tethered balloon system consists of the streamlined balloon and a tether made up of three discrete links. The derivation of nonlinear equations of motion for this system in three dimensions is presented. GRA

N72-30025# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
VARIABLE DIAMETER ROTOR STUDY Final Report, Jan. - Jul. 1971
Arthur W. Linden et al Wright-Patterson AFB, Ohio AFFDL Jan. 1972 211 p refs
(Contract F33615-71-C-1186; AF Proj. 1366)
(AD-740911; SER-50718; AFFDL-TR-71-170) Avail: NTIS CSCL 01/3

The report documents the findings of a variable diameter

rotor systems concept study which Sikorsky Aircraft performed. The objective of the study was to investigate the various schemes proposed for variable diameter rotors for compound helicopters, to determine the merits of each, and to conclude which is most promising. Three basic types of variable diameter rotors were investigated, classified by the type of rotor blade construction: telescoping rigid blades, folding rigid blades, and flexible blades. Examples of each of these were adapted to a large compound helicopter design. All aircraft were sized to perform the same mission and a quantitative analysis was performed which rated each design on overall system cost effectiveness. GRA

N72-30026# Defense Documentation Center, Alexandria, Va.
HEAVY LIFT HELICOPTERS Report Bibliography, Oct. 1962 - Jan. 1971
Apr. 1972 56 p refs
(AD-740900; DDC-TAS-72-16-1) Avail: NTIS CSCL 01/3

The bibliography contains unclassified references on heavy lift helicopters with a minimum payload of about 9,000 pounds or a minimum gross weight of 17,000 pounds. These references relate to rotor characteristics, rotor systems, rotor loads, lift propulsion, payloads, heavy lift rotors, configurations, design, and performance capabilities of the heavy lift helicopters. Computer-generated indexes of corporate author-monitoring agency, subject, personal author, and title are included. Author (GRA)

N72-30027# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE EFFECTS OF WIND AND TEMPERATURE GRADIENTS ON SONIC BOOM CORRIDORS
R. O. Onyeonwu Oct. 1971 39 p refs
(Grant AF-AFOSR-1885-70; AF Proj. 9781)
(AD-740897; UTIAS-TN-168; AFOSR-71-3087TR) Avail: NTIS CSCL 20/1

Calculation of sonic boom corridor widths based on closed form solutions of ray acoustic equations using piecewise linear atmospheric models of winds and temperatures has been accomplished. Detailed solutions of ray tracing equations are presented for all possible variations of winds and temperatures, within the framework of the assumed model atmosphere. The effects of aircraft flight altitude and Mach number, wind and temperature gradients, and wind direction on sonic boom corridor are investigated in detail, including the effects of non-standard atmospheres such as prevail in winter months. Numerical results are presented and amply discussed. Agreement of the present calculations with published data is excellent. Author (GRA)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators, and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N72-30028*# Pratt and Whitney Aircraft, East Hartford, Conn.
FUEL CELL TECHNOLOGY PROGRAM Final Report
27 Apr. 1972 82 p
(Contract NAS9-11034)
(NASA-CR-128518; PWA-4364) Avail: NTIS HC $6.25 CSCL 10A

A fuel cell technology program was established to advance the state-of-the art of hydrogen oxygen fuel cells using low temperature, potassium hydroxide electrolyte technology as the base. Cell and component testing confirmed that low temperature, potassium hydroxide electrolyte technology is compatible with the requirements of the space shuttle Phase B contractors. Testing of the DM-1 powerplant demonstrated all of the important requirements of the shuttle except operating life. Testing also identified DM-1 powerplant life limiting mechanisms; hydrogen pump gear wear and pressurization of the cell stack over its design limits. Author

N72-30029*# Pratt and Whitney Aircraft, East Hartford, Conn. South Windsor Engineering Facility.
FUEL CELL TECHNOLOGY PROGRAM CONTRACT SUMMARY REPORT Summary Report
24 Feb. 1972 21 p
(Contract NAS9-11034)
(NASA-CR-128519; PWA-4363) Avail: NTIS HC $3.25 CSCL 10A

A fuel cell technology program which was established to advance the state-of-the-art of hydrogen-oxygen fuel cells using the P and WA PC8B technology as the base is reported. The major tasks of this program consisted of (1) fuel cell system studies of a space shuttle powerplant conceptual design (designated engineering model -1, EM-1) supported by liaison with the space shuttle prime contractors; (2) component and subsystem technology advancement and; (3) a demonstrator powerplant test. Fuel cell system studies, with the EM-1 as the focal point of design activities, included determination of voltage regulation, specific reactant consumption, weight, voltage level and performance characteristics. These studies provided the basis for coordination activities with the space shuttle vehicle prime contractor. Interface information, on-board checkout and in-flight monitoring requirements, and development cost data were also provided as part of this activity. Even though the two vehicles primes had different voltage requirements (115 volts in one case and 28 volts in the other), it was concluded that either option could be provided in the fuel cell power system by the electrical hook-up of the cells in the stack. Author

N72-30030*# Eagle-Picher Co., Joplin, Mo. Couples Dept.
STUDY OF PROCESS VARIABLES ASSOCIATED WITH MANUFACTURING HERMETICALLY-SEALED NICKEL-CADMIUM CELLS Quarterly Report, Mar. - May 1971
Lee Miller May 1972 107 p refs
(Contract NAS5-21159)
(NASA-CR-122454; QR-5) Avail: NTIS HC $7.50 CSCL 10A

The effort and results of a program to determine and study the critical process variables associated with the manufacture of aerospace, hermetically-sealed, nickel-cadmium cells are reported. During the period, the impregnation/polarization process variable study was brought to a close with the completion of a series of related experiments. The results of the experiments are summarized. During this period, a general characterization of cell separator materials was initiated. The major conclusions resulting from the characterization of materials are included. Author

N72-30031*# Boeing Co., Seattle, Wash.
AN ADVANCED CONCEPT SECONDARY POWER SYSTEMS STUDY FOR AN ADVANCED TRANSPORT TECHNOLOGY AIRCRAFT Final Report
[1972] 160 p refs
(Contract NAS1-10893)
(NASA-CR-112103) Avail: NTIS HC $10.00 CSCL 10B

The application of advanced technology to the design of an integrated secondary power system for future near-sonic long-range transports was investigated. The study showed that the highest payoff is achieved by utilizing secondary power equipment that contributes to minimum cruise drag. This is best accomplished by the use of the dedicated auxiliary power unit concept (inflight APU) as the prime power source for an airplane with a body-mounted engine or by the use of the internal engine generator concept (electrical power extraction from the propulsion engine) for an airplane with a wing-pod-mounted engine. Author

N72-30032*# Tyco Labs., Inc., Waltham, Mass.
NiCd BATTERY ELECTRODES Final Report
G. Holleck, M. Turchan, and J. Hopkins May 1972 127 p refs

Prepared for JPL
(Contracts NAS7-100; JPL-953185)
(NASA-CR-127890) Avail: NTIS HC $8.50 CSCL 10C

The objective of this research program was to develop and evaluate electrodes for a negative limited nickel-cadmium cell and to prove its feasibility. The program consisted of three phases: (1) the development of cadmium electrodes with high hydrogen overvoltage characteristics, (2) the testing of positive and negative plates, and (3) the fabrication and testing of complete negative limited NiCd cells. The following electrode structures were manufactured and their physical and electrochemical characteristics were evaluated: (1) silver sinter-based Cd electrodes, (2) Teflon-bonded Cd electrodes, (3) electrodeposited Cd sponge, and (4) Cd-sinter structures. All cadmium electrode structures showed a sharp increase in potential at the end of charge, with the advent of hydrogen evolution occurring at approximately -1.3 V versus Hg/HgO. The hydrogen advent potentials on pure cadmium structures were 50 to 70 mV more cathodic than those of their silver-containing counterparts.
Author

N72-30033*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE 110 WATT PER KILOGRAM LIGHTWEIGHT SOLAR ARRAY SYSTEM Quarterly Report
N. F. Shepard and A. Schneider 15 Aug. 1972 126 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953387)
(NASA-CR-127889; DOC-72SD4233; QR-1) Avail: NTIS HC $8.50 CSCL 10A

This ultralightweight solar array system is applied to three generic mission types: (1) interplanetary, (2) geosynchronous, and (3) manned space station. The requirements of each of these missions, as they pertain to the solar array, are presented. Existing lightweight solar array system concepts are reviewed, along with conclusions regarding the applicability of this technology to the feasibility of the ultralightweight solar array system. Several system concepts are included for further evaluation. The existing technology base, as it pertains to solar cells, solar cell covers, interconnects and substrates, and deployable booms, is reviewed. The attitude control of spacecraft with large flexible solar arrays is also discussed. Author

N72-30034*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TESTS OF HELIOTEK DIVISION, TEXTRON, INCORPORATED, 20.0 AMPHERE-HOUR NICKEL-CADMIUM CELLS
D. E. Christy 15 Mar. 1972 21 p
(NASA Order S-23404-G)
(NASA-CR-127813; AD-739740; QEEL/C-72-101) Avail: NTIS HC $3.25 CSCL 10A

The results are reported of the acceptance tests of ten nickel-cadmium spacecraft cells rated at 20.0 ampere-hours. It was found that the cells ranged from 15 to 20.3 ampere-hours; only one cell delivered the rated capacity; none of the cells reached 1.50 volt limit during overcharge; and no leaks were found on the final tests. F.O.S.

N72-30035*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JUNCTION CHARACTERISTICS OF SILICON SOLAR CELLS. PART 1: NONILLUMINATED CASE
Richard J. Stirn 15 Aug. 1972 18 p refs
(Contract NAS7-100)
(NASA-CR-128029; JPL-TM-33-557-Pt-1) Avail: NTIS HC $3.00 CSCL 10A

Precise values of the reverse saturation currents in silicon solar cells and magnitudes of the diffusion and recombination components have been obtained. The recombination current as well as leakage current due to shunting are shown to be nonuniform across the cell. The diffusion lengths calculated from the diffusion current components agree well with diffusion lengths measured independently in similar material. Models are given demonstrating the effect of recombination and shunting currents on the dark current-voltage characteristics of solar cells.
Author

N72-30036*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS-INJECTION-START AND SHUTDOWN CHARACTERISTICS OF A 2-KILOWATT TO 15-KILOWATT BRAYTON POWER SYSTEM
Dennis A. Cantoni Washington Sep. 1972 18 p refs
(NASA-TN-D-6938; E-6996) Avail: NTIS HC $3.00 CSCL 10B

Two methods of starting the Brayton power system have been considered: (1) using the alternator as a motor to spin the Brayton rotating unit (BRU), and (2) spinning the BRU by forced gas injection. The first method requires the use of an auxiliary electrical power source. An alternating voltage is applied to the terminals of the alternator to drive it as an induction motor. Only gas-injection starts are discussed in this report. The gas-injection starting method requires high-pressure gas storage and valves to route the gas flow to provide correct BRU rotation. An analog computer simulation was used to size hardware and to determine safe start and shutdown procedures. The simulation was also used to define the range of conditions for successful startups. Experimental data were also obtained under various test conditions. These data verify the validity of the start and shutdown procedures. Author

N72-30037*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR CELL CONTACT PULL STRENGTH AS A FUNCTION OF PULL-TEST TEMPERATURE
Robert K. Yasui and Paul A. Berman 15 Aug. 1972 38 p refs
(Contract NAS7-100)
(NASA-CR-127888; JPL-TR-32-1563) Avail: NTIS HC $4.00 CSCL 10A

Four types of solar cell contacts were given pull-strength tests at temperatures between -173 and +165 C. Contacts tested were: (1) solder-coated titanium-silver contacts on n-p cells, (2) palladium-containing titanium-silver contacts on n-p cells, (3) titanium-silver contacts on 0.2-mm-thick n-p cells, and (4) solder-coated electroless-nickel-plated contacts on p-n cells. Maximum pull strength was demonstrated at temperatures significantly below the air mass zero cell equilibrium temperature of +60 C. At the lowest temperatures, the chief failure mechanism was silicon fracture along crystallographic planes; at the highest temperatures, it was loss of solder strength. In the intermediate temperatures, many failure mechanisms operated. Pull-strength tests give a good indication of the suitability of solar cell contact systems for space use. Procedures used to maximize the validity of the results are described. Author

N72-30038*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT, VOLUME 1, BOOK 1 Final Technical Report, Apr. 1969 - Dec. 1971
R. E. Andrews, ed. 15 Jun. 1972 282 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952536)
(NASA-CR-127914; DIN-72SD4223-Vol-1-Bk-1) Avail: NTIS HC $16.25 CSCL 10A

Equipment was designed to receive power from a radioisotope thermoelectric generator source, condition, distribute, and control this power for the spacecraft loads. The TOPS mission, aimed at a representative tour of the outer planets, would operate for an estimated 12 year period. Unique design characteristics required for the power conditioning equipment results from the long mission time and the need for autonomous on-board operations due to large communications distances and the associated time delays of ground initiated actions. The salient features of the selected power subsystem configuration

are: (1) The PCE regulates the power from the radioisotope thermoelectric generator power source at 30 vdc by means of a quad-redundant shunt regulator; (2) 30 vdc power is used by certain loads, but is more generally inverted and distributed as square-wave ac power; (3) a protected bus is used to assure that power is always available to the control computer subsystem to permit corrective action to be initiated in response to fault conditions; and (4) various levels of redundancy are employed to provide high subsystem reliability. Author

N72-30039*# General Electric Co., Philadelphia, Pa. Space Div.
POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT, VOLUME 1, BOOK 2 Final Technical Report
R. E. Andrews, ed. 15 Jun. 1972 395 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952536)
(NASA-CR-127868; DIN-72SD4223-Vol-1-Bk-2) Avail: NTIS HC $21.75 CSCL 10A

The design and development of power conditioning equipment for the thermoelectric outer planet spacecraft program are considered. One major aspect of the program included the design, assembly and test of various breadboard power conditioning elements. Among others these included a quad-redundant shunt regulator, a high voltage traveling wave tube dc-to-dc converter, two-phase gyro inverters and numerous solid state switching circuits. Many of these elements were arranged in a typical subsystem configuration and tests were conducted which demonstrated basic element compatibility. In parallel with the development of the basic power conditioning elements, system studies were continued. The salient features of the selected power subsystem configuration are presented.
Author

N72-30040*# Globe-Union, Inc., El Monte, Calif.
RESEARCH, DEVELOPMENT AND FABRICATION OF LITHIUM SOLAR CELLS, PART 2
Peter Iles, A. Apr. 1972 54 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952546)
(NASA-CR-127483) Avail: NTIS HC $4.75 CSCL 10A

The development and fabrication of lithium solar cells are discussed. Several single-step, lithium diffusion schedules using lower temperatures and times are described. A comparison was made using evaporated lithium metal as the lithium source, and greatly improved consistency in lithium concentrations was obtained. It was possible to combine all processing steps to obtain lithium doped cells of high output which also contained adequate lithium to ensure good recoverability. Author

N72-30041# Pratt and Whitney Aircraft, East Hartford, Conn.
DUAL CELL REGENERATIVE FUEL CELL INVESTIGATION Final Report, 22 Jun. 1970 - 30 Jan. 1972
J. K. Stedman and D. Baillieul Wright-Patterson AFB, Ohio AFAPL Apr. 1972 82 p
(Contract F33615-70-C-1670; AF Proj. 3145)
(AD-741839; PWA-4401; AFAPL-TR-72-19) Avail: NTIS CSCL 10/2

An analytical and exploratory development program was conducted on an integrated dual cell design of a hydrogen-oxygen regenerative fuel cell. Discussed is a design which employs separate fuel cell and electrolysis cells in a single container which also acts as a reactant pressure vessel. The alkaline matrix cells are arranged on two concentric cylinders within the pressure vessel with water transport accomplished by vapor diffusion across the hydrogen gap separating the cell cylinders. The performance and endurance potential of the dual cell concept was evaluated. The fuel cell is being designed for use in satellites to overcome the problem of power generation during solar eclipse. Author (GRA)

N72-30042# Army Foreign Science and Technology Center, Charlottesville, Va.
THERMOEMISSION ENERGY CONVERTERS
B. V. Eliseev, A. P. Pyatnitskii, and D. I. Sergeev Mar. 1972 105 p refs Transl. into ENGLISH of mono. "Termoemissionnye preobrazovateli energii" Moscow, 1970
(AD-742054; FSTC-HT-23-232-72) Avail: NTIS CSCL 10/2

Autonomous and transportation energetics in the near future will require the development of new sources of electrical energy: thermoemission generators. The book is devoted to a popular presentation of the operating principles and hardware of thermoemission generators. The book is intended for a wide class of readers interested in problems of direct conversion of thermal and nuclear energy into electrical energy and in the advantages and fields of application of these generators of electrical energy. Author (GRA)

N72-30043# Harry Diamond Labs., Washington, D.C.
COMPARISON OF POTENTIAL STEP AND TRIANGULAR VOLTAGE SWEEP METHODS OF DOUBLE LAYER CAPACITANCE MEASUREMENTS. 3: POROUS ZINC ELECTRODES
W. H. Steuernagel Mar. 1972 22 p refs
(HDL Proj. 9EC94; DA Proj. 1T0-61102-A-34-A)
(AD-742219; HDL-TR-1579) Avail: NTIS CSCL 07/4

The double layer capacitance (DLC) of porous zinc electrodes in 31 percent KOH was measured by both the potential step method and the potential sweep method at -40 C. The methods yielded similar results, but the potential step method provides additional useful information about the charging process of the double layer. Relating the DLC data to the gravimetric BET (gas absorption method) surface areas yielded a specific capacitance for porous zinc at -40 C. Author (GRA)

N72-30044# Army Foreign Science and Technology Center, Charlottesville, Va.
THE EFFECT OF IMPURITIES ON THE THERMAL EFFICIENCY OF A SHORT CIRCUITED GENERATOR
L. I. Anatychuk and V. T. Dimitrashchuk 28 Jan. 1972 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk, USSR), No. 8, 1970 p 7
(AD-741727; FSTC-HT-23-1575-71) Avail: NTIS CSCL 10/2

Theoretical calculations and experimental results show that the thermal efficiency of a short circuited generator can be made significantly higher than that of the usual anisotropic generator. Results are found to depend both on the degree of anisotropy and on the crystal orientation. GRA

N72-30045# Harry Diamond Labs., Washington, D.C.
ORGANIC ELECTROLYTE BATTERY SYSTEMS
Jeffrey T. Nelson and Carla F. Green Mar. 1972 109 p refs
(DA Proj. 1T0-61102-A-34A)
(AD-741786; HDL-TR-1588) Avail: NTIS CSCL 10/3

A search of the pertinent literature on organic electrolyte battery systems has been conducted to determine which systems, if any, might be useful to fuze power supplies. The data found in the literature, evaluated in the light of the requirements necessary for such power supplies, were found to be not specifically applicable, but useful only in a qualitative sensz. A plan of study and a list of three anodes, eight solvents, seven solutes, and seven cathodes derived from these data are presented. Author (GRA)

N72-30046# United Research Services, San Mateo, Calif.
IMPROVISING ELECTRIC POWER FROM INDUCTION GENERATORS DURING PROLONGED POWER OUTAGES Final Report
Robert H. Black Sep. 1971 73 p refs
(Contract DAHC20-71-C-0277)
(AD-741386; URS-7036-5) Avail: NTIS CSCL 10/2

The objective of the work is to: Determine the feasibility of using large induction motors as induction generators; Work out

the problems attendant with using engine generators and induction generators as improved or temporary sources of electric power during prolonged power outages; Prepare the manuscript for a guidance and procedures manual for utilizing emergency power sources. Author (GRA)

N72-30047# Atomics International, Canoga Park, Calif.
BASIC RESEARCH IN THERMIONIC ENERGY CONVERSION Technical Summary Report, 1 Dec. 1970 - 30 Nov. 1971
Lorin K. Hansen and Charles Warner Mar. 1972 142 p refs
(Contract N00014-70-C-0196; NR Proj. 099-346)
(AD-740121; AI-72-7) Avail: NTIS CSCL 10/2

The report presents the results of the past year's work in a program to investigate basic process in thermionic diodes which are important to the realization of practical thermionic energy conversion. The subjects discussed are cesium and cesium-oxygen adsorption on refractory metals, and includes a computer program for calculating thermionic converter I-V characteristics. Author (GRA)

N72-30048# RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF THE ENVIRONMENT AND ELECTRIC POWER GENERATION
Sylvain Denis Feb. 1972 33 p refs
(AD-741605; P-4777) Avail: NTIS CSCL 10/2

The paper is a review of the available information about the relationship between electric power generation and the environment. The focus has been primarily on the cost estimates for devices intended to control pollution. Author (GRA)

N72-30049# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
POWER SHARING WITH ELECTRIC PROPULSION AND SECONDARY BATTERIES Technical Report, Nov. 1970 - Apr. 1971
Jack W. Geis Dec. 1971 82 p refs
(AF Proj. 3141)
(AD-740571; AFAPL-TR-71-42) Avail: NTIS CSCL 10/2

An in-house study has revealed that most AF synchronous equatorial satellites have an appreciable fraction of power on the spacecraft which is not being used continuously. The study reveals that this excess power may be used to operate electric thrusters for stationkeeping functions, on an appropriate duty cycle. By selecting the proper secondary battery charge rate, commensurate with battery capacity and reliability, the electric thruster performance may be optimized to maximize satellite payload capabilities. Percent payload improvement from a few percent to 25% when compared to a non-power-sharing ion engine, and from 5 to 75% compared to a power-sharing colloid engine may be realized. Author (GRA)

N72-30050# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
SOLAR CELL RADIATION RESPONSE NEAR THE INTERFACE OF DIFFERENT ATOMIC NUMBER MATERIALS
E. A. Burke, J. R. Cappelli, L. F. Lowe, and J. A. Wall 24 Nov. 1971 20 p refs
(AF Proj. 5621)
(AD-740577; AFCRL-72-0045; PSRP-472) Avail: NTIS CSCL 10/2

The response of Co-60 irradiated N/P silicon solar cells was measured as a function of the atomic number of the medium adjacent to the cell and the direction of the gamma ray beam. The interpositioning of various thicknesses of aluminum between the adjacent material and the cell had the effect of moving the cell to various locations in an approximate monoatomic numbered medium. With this technique, the solar cell response was determined at various distances from the interface for gold and beryllium. Ionization chamber data were used to estimate the influence of various base contact materials. Author (GRA)

N72-30051# Army Electronics Command, Fort Monmouth, N.J.
LIMITING FACTORS FOR ZINC-AIR BATTERIES AT LOW AND ELEVATED TEMPERATURES
Carl A. Nordell Mar. 1972 35 p
(DA Proj. 1T6-62705-A-053)
(AD-741340; ECOM-3553) Avail: NTIS CSCL 10/3

Zinc-air batteries offer significant advantages over conventional primary and secondary batteries in terms of weight, power capability, and mechanical recharge for manpack electronic equipment. However, serious problems exist in maintaining the inherently high energy density under intermittent discharge conditions at both low temperatures (below 32 F) and elevated temperatures (up to 160 F). The report covers an investigation of factors influencing and/or limiting the performance of mechanically rechargeable zinc-air cells under these conditions and makes recommendations for design and operation to extend the performance capability. While it is true that the tests reported were conducted on mechanically rechargeable zinc-air cells, most of the conclusions and recommendations can be applied to the primary water activated zinc-air cell as well. Author (GRA)

N72-30052# Army Electronics Command, Fort Monmouth, N.J.
SECONDARY ZINC-AIR CELL INVESTIGATIONS
Otto C. Wagner Apr. 1972 36 p refs
(DA Proj. 1T6-62705-A-053)
(AD-741342; ECOM-3558) Avail: NTIS CSCL 10/3

Zinc-air cells have been developed that are capable of delivering over 50 cycles. These cells were constructed with silver-amalgam air-cathodes, nickel screen charging electrodes, and teflonated zinc anodes. The major failure modes encountered in this study were: shorting by zinc penetration, loss of capacity by the zinc anode due to edge-corrosion and surface densification, platinum poisoning of the zinc anode when employing platinum-catalyzed air-cathodes, and passivation of the zinc anode by electrolyte starvation. The means of overcoming these problems are presented. Author (GRA)

N72-30053# Army Foreign Science and Technology Center, Charlottesville, Va.
OPERATIONAL CHARACTERISTICS OF TYPE BETA-1 AND BETA-2 ISOTOPIC THERMOELECTRIC GENERATORS
G. M. Fradkin, V. M. Kodyukov, A. I. Ragczinskii, N. P. Korotkov, and E. A. Kazakov 12 Dec. 1972 13 p refs Transl. into ENGLISH from Tr. Vses. Nauchn.-Issled. Inst. Radiat. Tekhn. (USSR), no. 4, 1970
(AD-741111; FSTC-HT-23-340-72) Avail: NTIS CSCL 10/2

Both generators were tested in use, supporting meteorological stations. The characteristics of the Beta-1 varied from the predicted values with time, but never by as much as 10%. The Beta-2 was found to be particularly safe and reliable in operation over extended periods, and can be used for terms of 5 years or more. GRA

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N72-30054*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 103, MAY 1972
Jun. 1972 116 p refs
(NASA-SP-7011(103)) Avail: NTIS HC $3.00 CSCL 06E

This special bibliography lists 363 reports, articles, and other documents introduced into the NASA scientific and technical information system in May 1972. Author

N72-30055*# Milan Univ. (Italy). Dept. of Human Physiology.
ORBITING FROG OTOLITH EXPERIMENT (OFO-A): DATA REDUCTION AND CONTROL EXPERIMENTATION Final Report
Torquato Gualtierotti, Francesco Bracchi, and Emilio Rocca Jan. 1972 353 p refs
(Contract NASw-2211)
(NASA-CR-62084) Avail: NTIS HC $19.75 CSCL 06C

The OFO-A mission was prepared as a part of a special program of vestibular physiology with the purpose of studying in which way the lack of the gravity pull will affect the functioning of that part of the labyrinth which controls balance. The gravitational components corresponded to the different head positions, namely, the gravity sensitive or positioning receptors. It is evident that in weightlessness the gravity sensitive receptors are deprived of their primary input. Author

N72-30056*# Mississippi Univ., Jackson. Dept. of Physiology and Biophysics.
DIGITAL SIMULATION AND EXPERIMENTAL EVALUATION OF THE CO2-H(PLUS) CONTROL OF PULMONARY VENTILATION Final Technical Report
Howard T. Milhorn, Jr. and W. J. Reynolds 28 Jun. 1972 13 p refs
(Grant NGR-25-002-015)
(NASA-CR-127819) Avail: NTIS HC $3.00 CSCL 06P

Previous models of the CO2-H(+) control of ventilation have been concerned either with the response to CO2 inhalation, or the response to perfusion of the surface of the medulla with mock cerebrospinal fluid having a high P sub CO2. Simulation of both responses with the same model has not been attempted. The purpose of the present study was two fold; first to develop such a model and, second, to obtain experimental data from human subjects for both developing this model and for evaluating this and future models. Author

N72-30057*# Scientific Translation Service, Santa Barbara, Calif.
COMPARATIVE CHARACTERISTICS OF NUCLEOTIDE DNA BLOCKS IN RADIATION INJURY AND LEUKOSIS
A. Oparin Washington NASA Aug. 1972 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 203, no. 1, Mar. - Apr. 1972 p 233-236
(Contract NASw-2035)
(NASA-TT-F-14520) Avail: NTIS HC $3.00 CSCL 06R

DNA block analysis shows changes in the hematopoietic system of animals in radiation which resemble those in leukosis. In both, a portion of nucleotide DNA blocks is damaged, while the relative amount of isolated thymidylnucleotide residue is increased. It is assumed that the development of cancer-like tissue in irradiated organisms can lead to later cancer or leukosis. Author

N72-30058*# Scientific Translation Service, Santa Barbara, Calif.
MECHANISMS OF CHANGES IN ENZYME ACTIVITY IN THE SMALL INTESTINE AT HIGH TEMPERATURES
A. Yu. Yunusov, K. Rakhimov, U. Z. Kadyrov, and N. A. Korotkina Washington NASA Aug. 1972 5 p refs Transl. into ENGLISH from Uzbeksk. Biol. Za. (Tashkent), no. 6, Nov. - Dec. 1971 p 21-23
(Contract NASw-2035)
(NASA-TT-F-14521) Avail: NTIS HC $3.00 CSCL 06P

Depletion of water in the organism changes enzyme activity in small rodents subjected to high temperatures and solar radiation. Under the effect of these stresses, amylolitic activity remained relatively stable, invertase activity decreased, and dipeptidase activity fluctuated. Alkaline phosphatase activity increased in all tests. Author

N72-30059*# Scientific Translation Service, Santa Barbara, Calif.
ROLE OF MITOCHONDRIAL BIOGENESIS IN ADAPTATION OF THE ORGANISM TO ALTITUDE HYPOXIA
F. Meyerson, V. Pomoynitskiy, and B. Yampolskaya Washington NASA Aug. 1972 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), 1972 p 973-976
(Contract NASw-2035)
(NASA-TT-F-14524) Avail: NTIS HC $3.00 CSCL 06C

Studies of the dynamics of DNA, RNA and protein synthesis in mitochondria and nuclei of the heart muscles of rats during adaptation to the continuous effect of high altitude hypoxia are reported. A marked increase is indicated in mitochondrial DNA and RNA synthesis after 10 days of adaptation, which is maintained for the next 30 days. Simultaneous nuclear and mitochondrial activation results in the synthesis and mitochondrial protein and mitochondrial biogenesis. This activation is triggered by decreased macroerg concentration due to environmental stresses. Author

N72-30060# Civil Aeromedical Inst., Oklahoma City, Okla.
AVIATION MEDICINE TRANSLATIONS: ANNOTATED BIBLIOGRAPHY OF RECENTLY TRANSLATED MATERIAL, 7
Karen N. Jones, D. R. Goulden, and E. Jean Grimm May 1972 8 p refs
(FAA-AM-72-16) Avail: NTIS HC $3.00

An annotated bibliography of translations of foreign-language articles is presented. The 29 listed entries are concerned with studies of vestibular function, optokinetic nystagmus, positional nystagmus, alcohol, determination of specific gravity, noise, physiology, biochemical analysis, vision, cardiology, driving safety, anatomy, anti-smoke hoods, flight safety, and animal behavior. Procedures for obtaining copies of the translations are included. Author

N72-30061# Federal Aviation Administration, Oklahoma City, Okla. Flight Standards Technical Div.
THE EFFECTS OF 2,2 DICHLOROVINYL DIMETHYL PHOSPHATE (DDVP) USED AS AN AIRCRAFT DISINSECTANT Final Report
James W. Ross, Jr. Dec. 1971 113 p refs Revised
(FS-70-601-120A) Avail: NTIS HC $7.75

A study to assess alleged hazards of exposing aircraft and passengers/crew to DDVP vapor for insecticidal purposes on international flights is reported. The study criteria focused on the effects of multiple exposure to the proposed disinsection environment under representative flight conditions. Particular relationships considered were: (1) human toxicology at cabin altitude; (2) flammability characteristics of cabin decorative materials; (3)performance of electronic/avionic equipment; and (4) corrosion of airframe components. Human subjects exposed to a conservative DDVP environment exhibited no characteristics of DDVP toxicity at ground level or at 8,000 ft. altitude. Cabin interior materials showed no measurable change in flammability characteristics after a DDVP treatment equivalent to 3 and 12 months operational exposure. Functional testing of representative avionics equipment produced no premature malfunction under conditions of cyclic altitude with concurrent DDVP exposure. It was concluded that the proposed DDVP disinsection environment would have no degrading effects on safety of flight. Author

N72-30062*# Scientific Translation Service, Santa Barbara, Calif.
FUNDAMENTALS OF AVIATION MEDICINE
A. A. Lavnikov Washington NASA Jul. 1972 297 p refs Transl. into ENGLISH of the publ. "Osnovy Aviatsionnoy Meditsiny" Moscow, Military Press, 1971
(Contract NASw-2035)
(NASA-TT-F-711) Avail: NTIS HC $3.00 CSCL 06E

The historical development of aviation medicine in our country is reviewed. The structure of the earth's atmosphere, a survey of human anatomy and physiology, and the effect of various flight factors on man are also discussed. The physiological and hygienic requirements for cabins of modern aircraft and the oxygen-respiration apparatus are specified, along with particular

aspects of flights under difficult meteorological conditions and at night affecting the pilot's body. The problems involved in feeding a flight crew are discussed. Author

N72-30063# Central Inst. for the Deaf, St. Louis, Mo. Central Inst. for the Deaf.
EFFECTS OF NOISE ON PEOPLE
31 Dec. 1971 165 p refs
(Contract EPA-68-01-05000)
(NTID300.7) Avail: NTIS HC $10.25

It is shown that noises can act as sources of psychological distress, either because of responses directly to the noise itself or because of responses to irrelevant messages carried by the sound. Psychological distress in turn contributes to the various unpleasant effects as hearing loss, speech interference, noisiness, anxiety, distress, etc. G.G.

N72-30064*# Sandia Labs., Albuquerque, N.Mex. Planetary Quarantine Dept.
PLANETARY QUARANTINE ACTIVITIES Final Report, Apr. 1965 - Jun. 1972
Aug. 1972 101 p refs
(NASA Order W-12853)
(NASA-CR-127835; SC-RR-72-0516) Avail: NTIS HC $7.25 CSCL 06M

The activities of the Planetary Quarantine Department at Sandia Laboratories during the period April 1965 through June 1972 are summarized. Included are the rationale, the methods, and the results of modeling and experimentation used in dry heat, radiation, thermoradiation, and chemical sterilization studies. Publications describing these activities and accounts of closely related research are also furnished. Author

N72-30065*# Mississippi State Univ., State College. Dept. of Microbiology.
MICROBIAL DEGRADATION OF PARATHION Ph.D. Thesis
William Leonard Gibson Aug. 1972 125 p refs
(Grant NGL-25-001-040)
(NASA-CR-127913) Avail: NTIS HC $8.25 CSCL 06M

An organism capable of utilizing parathion as the sole carbon and energy source was isolated by enrichment culture techniques. The bacterium was characterized and tentatively classified as Pseudomonas aeruginosa. A pH of 7.0 - 7.5 and temperature of 30 C were found to be optimum for the consumption of parathion. Virtually no oxygen utilization was observed with resting cell suspensions when nonsolubilized parathion was employed. The use of ethanol as solvent for parathion in resting cell studies or preincubation of cells in ethanol obviated this problem and rapid parathion oxidation was demonstrable. Approximately 80% of the parathion consumed by resting cells was present terminally as carbon dioxide. Permeability of the cell to parathion or its metabolites was contingent upon the use of ethanol as either solvent or denaturant. Metabolites were tentatively identified by thin layer chromatography. Author

N72-30066# Civil Aeromedical Inst., Oklahoma City, Okla.
THE USE OF SIMPLE INDICATORS FOR DETECTING POTENTIAL CORONARY HEART DISEASE SUSCEPTIBILITY IN THE AIR TRAFFIC CONTROLLER POPULATION
Michael T. Lategola May 1972 8 p refs
(FAA-AM-72-20) Avail: NTIS HC $3.00

An analysis was made of an eight-year interval change in several indicators of coronary heart disease (CHD) susceptibility as measured 23,826 male ATC personnel. The data were obtained from current aeromedical certification records in January 1971. The distributions of resting blood pressure (BP), resting heart rate (HR) and the 400 pathology code frequency were compiled in age versus Framingham relative weight index (FRWI) tables. Obesity was defined as a minumum FRWI of 120.0%. Substantiating earlier findings, all parameters generally increased with age and obesity. These findings are directly relevant to the mass aeromedical screening, early detection, susceptibility reversal and preventive aspects of CHD. Author

N72-30067# Civil Aeromedical Inst., Oklahoma City, Okla.
RESIDUAL PERFORMANCE EFFECTS OF SIMULATED SONIC BOOMS INTRODUCED DURING SLEEP
W. Dean Chiles and Georgetta West May 1972 9 p refs
(FAA-AM-72-19) Avail: NTIS HC $3.00

Twenty-four male subjects were tested on a complex performance device involving monitoring, mental arithmetic, and pattern discrimination. Three age-groups were used: 20 to 26, 40 to 45, and 60 to 72. Subjects were tested for 30 minutes each morning and each evening for a 21-day period. On the sixth through the 17th nights, subjects were exposed to eight simulated sonic booms with an outdoors overpressure level of 1.0 psf presented at 1-hour intervals during sleep. The results provided no evidence that exposure to simulated sonic booms during sleep produced measurable consequences with respect to complex performance. A significant age effect was found for five of the ten measures. Significant differences (apparently a learning effect) were found in performance across the three phases (pre-boom, boom, and post-boom). There was also a significant interaction between age and phase for five of the measures. Analysis of the simple effects indicated there were rather large differences among the three groups at the beginning of testing with the differences decreasing in the two latter phases. The time-of-day effect was significant for five of the measures. Author

N72-30068*# Mississippi State Univ., State College. Dept. of Microbiology.
ENHANCED DEGRADATION OF ALUMINUM METAL IN THE PRESENCE OF SELECTED MICROORGANISMS M.S. Thesis
John Marion Tennyson Aug. 1972 61 p refs
(Grant NGL-25-001-028)
(NASA-CR-127864) Avail: NTIS HC $5.25 CSCL 06M

Experiments were conducted to determine the effects of microorganisms, substrates, pressures, humidities, and oxygen concentrations upon aluminum corrosion. In addition, the effects of microbes upon coated and treated aluminum were examined and an attempt to correlate aluminum in solution with degradation of the samples was undertaken. The organisms, humidities, oxygen levels, and substrates all played a major role in the corrosion of aluminum. Quantitation of aluminum losses indicated that the total metal losses from inoculated samples were significantly greater than those of the uninoculated samples. Author

N72-30069# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
MATHEMATICS IN BIOLOGY AND MEDICINE Technical Progress Report, 1 Jun. 1971 - 31 May 1972
Richard Bellman 31 May 1972 47 p refs
(Grant GM-16197-04)
(USCEE-418) Avail: NTIS HC $4.50

Conceptual, analytic and computational methods of modern mathematics to treat biomedical problems are considered. Major efforts are devoted to chemotherapy and radiotherapy using the mathematical theory of control and decision processes, (dynamic programming), to utilize beneficial patient dosage treatment without harmful side-effects. Computerized drug regimen programs have been developed for digitoxin and kanamycin, and important savings have been made in the time required for tumor scanning using techniques of nuclear medicine. In the field of mental health, computerized simulation processes using graphics were obtained. Major mathematical breakthroughs have been made in the treatment of large scale systems, and in patient identification processes. Author

N72-30070*# George Washington Univ., Washington, D.C. Dept. of Medical and Public Affairs.
INFORMATION SERVICES FOR COMPARATIVE ANALYSIS OF BIORHYTHM RESERACH Final Report
May 1972 210 p refs
(Contract NAS2-6216)

(NASA-CR-114487) Avail: NTIS HC $12.50 CSCL 06P

References and full text documents are presented in support of continuing research and research planning for the NASA behavioral physiology program. Areas covered include: (1) desynchronosis and performance; (2) effects of alcohol, common colds, drugs, and toxic hazards on performance; (3) effects of stress on rhythm of plasma steroids; (4) data processing of biological rhythms; (5) pharmacology and biological rhythms; (6) mechanisms of biological rhythms; and (7) development of biological rhythms. A.L.

N72-30071# *Sandia Labs., Albuquerque, N.Mex.*
PLANETARY QUARANTINE PROGRAM Quarterly Report, period ending 31 Dec. 1971
Dec. 1971 61 p refs
(TID-25965; QR-23) Avail: NTIS

An irradiation facility was designed which approximates the irradiation conditions expected in space with regard to UV solar flux and vacuum. Survival data for Bacillus subtilis spores and for suspensions of microorganisms occurring naturally in Cape Kennedy soil irradiated in the facility are presented. The results indicate that the vacuum effect alone had a slight capacity to inactivate microorganisms. There was a dramatic difference in the response of spores of B. subtilis and Cape Kennedy soil microorganisms. Spores of B. subtilis were essentially completely inactivated after exposure of 24 hr to vacuum and uv radiation, while bacteria in the soil preparations survived for up to six days. Possible explanations for the difference in radiosensitivity are discussed. NSA

N72-30072# Navy Experimental Diving Unit, Washington, D.C.
CALCULATION OF CUMULATIVE PULMONARY OXYGEN TOXICITY
W. Brandon Wright 1972 44 p
(AD-742468; NEDU-RR-2-72) Avail: NTIS CSCL 06/20

The use of elevated oxygen pressures in diving, treatment of decompression sickness, and hyperbaric oxygen therapy exposes the subject to the risk of oxygen toxicity of the lungs. At present no adequate guidelines exist to assist the physician in planning an oxygen exposure which will be safe from this hazard. The development of a method of calculating an estimated rate of onset and severity of pulmonary oxygen toxicity in man for any oxygen exposure has been reported. This report explains that method and provides tables that may be used to rapidly estimate the severity of pulmonary toxicity which may be incurred by any oxygen exposure. Recommendations as to safe limits of oxygen exposures for various procedures are included. Author (GRA)

N72-30073# School of Aerospace Medicine, Brooks AFB, Tex.
DETERMINATION OF REVISED AIR FORCE PERMISSIBLE EXPOSURE LEVELS FOR LASER RADIATION Technical Report, Jan. - Sep. 1970
Irving L. Dunsky, William A. Fife, and Everett O. Richey Apr. 1972 16 p refs
(AF Proj. 6301)
(AD-742267; SAM-TR-72-11) Avail: NTIS CSCL 06/8

Air Force permissible exposure levels were revised using experimental data from rhesus macaque monkeys and the concept of a minimal retinal spot. The ED/50 levels were annotated from the major sources which met the above criteria. ED/50 levels were annotated from the major sources which met the above criteria. ED/50 values reported for extramacular/paramacular exposures were corrected to the macula by multiplying by an experimentally determined average factor of 0.5. In addition, ED/50 values for neodymium exposures were corrected for ocular chromatic aberration to insure application of the data to a minimum retinal spot size and worst case situation. Safety factor considerations and values were examined and discussed for both the visible and near infrared wavelengths, resulting in reduction of existing Air Force permissible exposure levels. Author (GRA)

N72-30074# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE IMPLICATIONS OF A CEREBELLAR MODEL FOR THE MAMMALIAN RESPONSE TO MOVEMENT
Thomas W. Calvert and Frank Meno Dec. 1971 13 p refs
Presented at the Symp. on Biodyn. Models and their appl., Dayton, 26-28 Oct. 1970; Sponsored in part by PHS
(AF Proj. 7231)
(AD-740457; AMRL-TR-71-29-Paper-20) Avail: NTIS CSCL 06/19

A model for the cerebellum has been developed which shows that the cortex can be regarded as a spatial filter with interesting temporal characteristics. When this model is applied to the vestibulo-cerebellar system it predicts that the signal to the brain which results from acceleration applied to the skull has a trade-off between precision and time response. It appears that slowly changing accelerations will result in high precision information for the brain while a rapidly changing acceleration will result in lower precision information being sent to the brain. Author (GRA)

N72-30075# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
BIOMECHANICS IN MOTOR SKELETAL STRUCTURES
Carl Hirsch (Karolinska Inst., Stockholm) Dec. 1971 8 p
Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740456; AMRL-TR-71-29-Paper-19) Avail: NTIS CSCL 06/19

Most lethal biomechanical conditions can be explained by the physical laws which govern inertia, acceleration - deceleration and dissipation or absorption of kinetic energy. These physical laws provide a framework for the quantitative description of the mechanical response of skeletal structures. The time during which decelerations and forces are generated are of such magnitude to cause sudden fatalities. Studies of autopsy materials indicate that just below the level which causes sudden death, there is a narrow margin which may produce serious injuries and yet permit survival. There is thus a maximum tolerance of the body to force. Above this level, death occurs from stresses which exceed the limits of the structures with vital functional capacity. Author (GRA)

N72-30076# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
A THEORETICAL ANALYSIS: THE MECHANICAL CHARACTERISTICS OF THE PATELLA
Edward H. Miller (Cincinnati Univ.), Dane Miller (Cincinnati Univ.), and Robert Kroll (Cincinnati Univ.) Dec. 1971 18 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740455; AMRL-TR-71-29-Paper-18) Avail: NTIS CSCL 06/16

The authors have performed a theoretical static moment analysis of the knee joint, the quadriceps mechanism, and the patella. They have demonstrated that, theoretically, it should be impossible to extend the knee towards 180 degrees (maximum extension) against gravity and a theoretical ten pounds active resistive weight at the ankle joint because of the mechanics of the knee joint. They demonstrated that as the quadriceps mechanism lies on the anterior femoral condyle it would seem that, as the knee approached full extension, the line of pull of the quadriceps mechanism would approach 90 degrees to the moment at the tibial tubercule. In this analysis, the authors demonstrated why the patellectomized patient can indeed obtain full extension against gravity in an active resistive weight. Author (GRA)

N72-30077# Missouri Univ., Columbia. Space Sciences Research Center.
MECHANISMS OF OXYGEN TOXICITY AT THE CELLULAR

LEVEL Annual Report, 1 Jan. - 31 Dec. 1971
Olen R. Brown Jan. 1972 36 p refs
(Contract N00014-67-A-0287-0002; NR Proj. 136-756)
(AD-742443; AR-3) Avail: NTIS CSCL 06/20

Over the preceding year, progress has been achieved in several related lines of research which contribute to the contract objective of delineating basic, cellular mechanisms of oxygen toxicity. Each of the following areas has been previously identified with proposals and reports and progress in each area will be reviewed separately. The areas are: (A) techniques of measuring the toxicity of gaseous environments for cells, (B) quantification of the oxygen sensitivities of species and strains, (C) oxygen sensitivity of fatty acid synthetase and its components, and the effects of hyperoxia on: (D) pyridine nucleotide coenzymes, (E) oxidative phosphorylation, (F) cellular permeability, (G) respiration, and (H) cellular sulfhydryl. Author (GRA)

N72-30078# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
BRAIN FUNCTION AND ADAPTIVE SYSTEMS: A HETEROSTATIC THEORY
A. Harry Klopf 3 Mar. 1972 79 p refs
(AF Proj. 5632)
(AD-742259; AFCRL-SR-133; AFCRL-72-0164) Avail: NTIS CSCL 06/4

A new theory of intelligent adaptive systems is proposed. The theory provides a single unifying framework within which the neurophysiological, psychological, and sociological properties of living adaptive systems can be understood. Furthermore, the theory offers a new basis for the synthesis of machines possessing adaptive intelligence. The proposed theory is of a heterostatic type. That is to say, it is a theory which assumes that living adaptive systems seek, as their primary goal, a maximal condition (heterostasis), rather than assuming that the primary goal is a steadystate condition (homeostasis). It is further assumed that the heterostatic nature of animals, including man, derives from the heterostatic nature of neurons. The postulate that the neuron is a heterostat (that is, a maximizer) is a generalization of a more specific postulate, namely, that the neuron is a hedonist. This latter postulate is interpreted strictly in terms of physical variables, yielding the heterostatic neuronal model that is the basis for the detailed development of the theory. Author (GRA)

N72-30079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE DOSE FIELD OF AN ELECTRON BEAM
I. F. Moiseev, B. Ya. Narkevich, and V. N. Chernyavskii 11 Dec. 1971 10 p refs Transl. into ENGLISH from Vop. Dozim. Zashch. Izluch. (USSR), no. 9, 1969 p 77-81
(AD-739207; FTD-HT-23-1101-71) Avail: NTIS CSCL 06/18

A procedure is presented for calculating absorbed doses from electron sources (monoenergetic as well as those showing different spectral distribution in the energy interval 25 KeV-10 MeV) in tissue equivalent medium. A conversion from one source to another is accomplished in 3 stages which are explained. Results are compared with an experiment performed on a magnetic E monochromator (E energy of 1000 plus or minus 80 KeV, beam diam. 10 mm). The dose distribution was studied by using disk scintillators. Results differed by smaller than plus or minus 30 percent. Author

N72-30080# California Univ., Davis. Dept. of Human Physiology.
INVESTIGATION OF FACTORS AFFECTING HUMAN PERFORMANCE Final Report
Richard F. Walters 25 Feb. 1972 7 p
(Grant AF-AFOSR-1659-69; AF Proj. 9777)
(AD-740665; AFOSR-72-0741TR) Avail: NTIS CSCL 06/19

A predictive model of human performance has been under fairly constant revision as new experimental and other information becomes available and is incorporated into the model's design. The model illustrates techniques of interactive simulation, including tutorial assistance for the researcher unfamiliar with its operation, interruptible execution for adjustment of workload or environmental characteristics, and the ability to interrogate the status of any changing variable in the model. Models of acceleration and of the effects of long term exposure to extremely low humidity are in early phases of analyses. GRA

N72-30081# Missouri Univ., St. Louis. Inst. of Psychiatry.
AEROSPACE STRESS AND HUMAN RELIABILITY Final Report
Amedeo S. Marrazzi 6 Apr. 1972 22 p refs
(Grant AF-AFOSR-1821-69; AF Proj. 9777)
(AD-740666; AFOSR-72-0848TR) Avail: NTIS CSCL 05/10

Interaction with the external and internal environments is dependent on the information retrieval process. The interneuronal communication process essential to information retrieval and to cerebral integration generally has been the object of extensive study utilizing evoked field, focal, and extra- and intra-cellular unitary potentials as measures of synaptic output. In the process the investigators have worked out a means of checking adequacy of retrieval from association areas, which has enabled them to convert experimental findings into clinical test procedures able to assess breakdown point in subjects without actually breaking them down. This could be modified so as to behaviorally detect drug abusers and, with modification, detect drug abuse and its lasting consequences. Author (GRA)

N72-30082# Air Force Academy, Colo. Frank J. Seiler Research Lab.
POST-AWAKENING VISUALIZATION PERFORMANCE AS A FUNCTION OF ANXIETY LEVEL, REM OR NREM SLEEP, AND TIME OF NIGHT
Robert B. Tebbs Feb. 1972 79 p refs
(AF Proj. 7903)
(AD-738630; SRL-TR-72-0005) Avail: NTIS CSCL 05/10

On the basis of their Q4 scores (calm-tense) on the 16 PF, 16 calm and 16 moderately tense young adult male subjects were aroused twice each night on two non-consecutive nights in the laboratory and tested with two visualization tests in a 3- to 15-minute period after arousal. The REM and NREM awakenings were counterbalanced for early (about 1:00 A.M.) and late (about 3:00 A.M.) positions across nights and subjects. No REM-NREM effects were found on PAP. The TON effects were not interpreted, since awakenings could not be positioned according to the pre-experimental plan. No significant PAP differences were found between calm and tense subjects. One significant difference was found between PAP of night subjects and the performance of comparable day subjects. No difference was found between calm day and night subjects. The results strongly suggest that the most important determinant of PAP is the anxiety level of the subjects. Author

N72-30083# Army Medical Research Lab., Fort Knox, Ky.
THE MACH-DVORAK PHENOMENON AND BINOCULAR FUSION OF MOVING STIMULI Interim Report
George S. Harker 30 Nov. 1971 42 p refs
(DA Proj. 3A0-61102-B-71-P)
(AD-740656; USAMRL-951) Avail: NTIS CSCL 05/10

Depth judgments of the Mach-Dvorak phenomenon induced by cyclic, intermittent stimulation were used to assess eye coordination in binocular vision. The response to the experimental manipulations of the simultaneous and alternate neutral points, the points of zero and maximum disparity, was suggestive of the function of multiple neural processes. The data were strongly supportive of an interaction between direction of stimulus motion and interocular sequencing. Reduced illumination of one eye affected the time of occurrence of the simultaneous and alternate neutral points oppositely, dependent upon exposure conditions. The data for equal duration exposure condition were suggestive of the known nasal-temporal conductive latency difference. Author (GRA)

N72-30084# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

A MODEL TO SIMULATE THORACIC RESPONSES TO AIR BLAST AND TO IMPACT

E. R. Fletcher (Lovelace Found for Med, Educ. and Res., N. Mex) Dec. 1971 45 p refs Presented at the Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740438; AMRL-TR-71-29-Paper-1) Avail: NTIS CSCL 06/19

A fluid-mechanical model of the thorax is described which has been useful in explaining biophysical mechanisms and scaling procedures applicable in assessing responses of the thorax energized by air-blast overpressures or by nonpenetrating missiles. Methods of parameter estimation are discussed. Comparisons are made between measured and computed intrathoracic pressures and chest-wall motions. The tested mammalian species are shown to divide into two approximately similar groups and the implications of this are discussed. Suggestions are made concerning possible future areas of research. Author (GRA)

N72-30085# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

AN ANALYSIS OF THE PRESSURE WAVE GENERATED IN SEATED SPINAL IMPACT

Peter J. Torvik (AF Inst. of Tech.) Dec. 1971 27 p refs Presented at the Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740460; AMRL-TR-71-29-Paper-23) Avail: NTIS CSCL 06/9

Experiments performed on seated pentabarbitol anesthetized Macaca mulatta in order to study the response of the vertebral column and internal organs to spinal impact have revealed a spatio-temporal wave phenomenon along the torso during impact. Associated with this wave is a visible temporary abdominal distension. A mathematical model for such a mode of propagation is developed in this paper which enables the prediction of the parameters of a pressure wave in terms of certain physical properties of the subject. From the (closed form) results of the analysis, pressure, propagation speed, and skin stretch can be computed in terms of the speed at which the impact occurs. Although the model is necessarily simplified from the actual complex structure, the predicted relationships between the parameters show encouraging agreement with available experimental results. Author (GRA)

N72-30086# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

SOME CURRENT BIOMECHANICAL RESEARCH IN THE UNITED KINGDOM, AS RELATED TO THE EFFECTS OF IMPACT AND VIBRATION ON MAN

J. Sandover (Loughborough Univ. of Tech.) Dec. 1971 19 p refs Presented at Symp. on Biodyn. Model and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7321)

(AD-740440; AMRL-TR-71-29-Paper-3) Avail: NTIS CSCL 06/19

Although current research into models is not widely dispersed in the United Kingdom, models are used extensively as an aid to discussion. Current research includes the dynamics of wrist movements, the use of a model for tractor seat testing, and the properties of body tissue. Work at the author's establishment is directed towards providing a range of information on the human dynamic response to impact and vibration. Studies range from transient and steady-state impedance experiments, to internal and external transmissibility measurements. It is suggested that a wider understanding of variations and non-linearities is required before useful analytic, and synthetic models can be evolved.

Author (GRA)

N72-30087# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

USE OF A MATHEMATICAL MODEL FOR THE EVALUATION OF HEAD INJURY CRITERIA

James V. Benedict Dec. 1971 18 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740441; AMRL-TR-71-29-Paper-4) Avail: NTIS CSCL 06/19

The present study concerns the use of an analytic model for closed brain injury to evaluate General Motors: Severity Index for head injury. This index, which considers the relative importance of the duration and intensity of the pulse by means of an impulse-integration procedure, has been demonstrated empirically to be an excellent means of comparing the severity of pulses of varying shapes. Four pulses (square, half-sine, skewed and triangular), each having the same Severity Index but different magnitudes, were employed as inputs to the model. The model response to each of the four impacts was determined. Graphs of the time variation of stresses in the shell and pressures in the fluid at both the impact pole and at the counter pole demonstrate excellent correlation between model response and Severity Index, independent of the shape and magnitude of the impact force. Author (GRA)

N72-30088# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

MECHANICAL AND PHYSIOLOGICAL RESPONSE TO THE HUMAN CERVICAL VERTEBRAL COLUMN TO SEVERE IMPACTS APPLIED TO THE TORSO

Wolfgang Lange Dec. 1971 28 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740442; AMRL-TR-71-29-Paper-5) Avail: NTIS CSCL 06/19

In experiments with human cadavers, severe frontal and rear-end automobile collisions were simulated on an acceleration sled. A wide range of angles of rotation between head and torso resulted from the impacts. The magnitude of the torque exerted at the cervical spine was estimated using the mass moments and lever arms. Autopsies after the experiments indicated certain types of injuries to the intervertebral disks and the ligaments caused by torque, axial forces and shear forces. Obviously, preexperimental damages to the column by spondylitis and/or athrosis deformans are important parameters for the impact trauma. Author (GRA)

N72-30089# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

BIODYNAMIC MODELING AND SCALING: ANTHROPOMORPHIC DUMMIES, ANIMALS AND MAN

M. Kornhauser Dec. 1971 23 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740443; AMRL-TR-71-29-Paper-6) Avail: NTIS CSCL 06/19

After a brief outline of the applications and methods of biomechanics and the major sources of biodynamics data, the paper reviews the status of mathematical modeling, physical modeling (dummies) and scaling of models and damage levels. Biomechanics data required for preparing mathematical models, as well as for adjusting and validating the computer programs, are found to be insufficient for computational applications. Because of this paucity of supporting data, computer modzls are in general oversimplified and rudimentary, despite the availability of adequate computational techniques used in the aerospace industry. Physical models and the requirements for dynamic similarity are discussed. Although quantitative simulation is warranted under some circumstances, anthropomorphic dummies are expected to be of most value as visual aids and for purposes of demonstrating kinematic relationships between man and vehicle. Scaling from dummies to man and from animals to man is difficult to justify theoretically because of differences in

structure, size and modes of failure. However, damage scaling in terms of the inputs (G and delta-V) required for failure, is shown to be accurate enough for purposes of rough approximation.
Author (GRA)

N72-30090# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
MULTIDEGREE, NONLINEAR MATHEMATICAL MODELS OF THE HUMAN BODY AND RESTRAINT SYSTEMS: APPLICATIONS IN THE ENGINEERING DESIGN OF PROTECTIVE SYSTEMS
Raymond R. McHenry Dec. 1971 18 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740444; AMRL-TR-71-29-Paper-7) Avail: NTIS CSCL 06/19

The role of mathematical models of whole-body kinetics in the engineering design of protective systems for acceleration exposures of humans is discussed. A number of specific models of this type and corresponding engineering applications are described. Present limitations of the research technique and probable future developments are discussed. Author (GRA)

N72-30091# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
BONE ATROPHY BY INACTIVITY
Joachim H. Eichler Dec. 1971 22 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740448; AMRL-TR-71-29-Paper-11) Avail: NTIS CSCL 06/19

The development of bone atrophy caused by inactivity was investigated in experiments with Guinea pigs. 300 animals of an inbred strain were fixed by a pelvic plaster for different times. The breaking strength of femora was measured and the reduction of spongy bone determined by uncalcified bone sections. Moreover, bone remodelling, dry mass of bone, and mineral balance were tested in our experiments. Bone atrophy is developing rapidly depending upon time of immobilization, age, and sex. The calcium balance is negative from the first day of immobilization. Osteoporotic changes produced by inactivity are compared with results obtained after space flights.
Author (GRA)

N72-30092# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE MECHANICAL CHARACTERISTICS OF SKIN AND OTHER SOFT TISSUE AND THEIR MODELLING
R. M. Kenedi (Strathclyde Univ., Glasgow) Dec. 1971 21 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1971
(AF Proj. 7231)
(AD-740449; AMRL-TR-71-29-Paper-12) Avail: NTIS CSCL 06/5

A brief survey of attempts at mechanical characterization of human tissue as components of the body have been presented. It is concluded that human tissue from a mechanical point of view is a multi-component material, nonhomogeneous, anisotropic and clearly non linearly visco-elastic. As regards effective modelling it is suggested that both material simulation and rheologic modelling are likely to prove abortive and that the most promising attempts to date are based on simplified models of actual physical structure. It is patently obvious that much more factual data is needed over the whole spectrum not the least in respect of limit load carrying capacity of the body and its components. It is further suggested that such limit capacity should preferably be related to the onset of physiological impairment than to palpable tissue damage. Author (GRA)

N72-30093# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
ON SOME GEOMETRIC PROPERTIES OF HUMAN RIBS, 1
Sanford B. Roberts (Calif. Univ., Los Angeles) and Ping Heng Chen (Calif. Univ., Los Angeles) Dec. 1971 26 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AD-740450; AMRL-TR-71-29-Paper-13) Avail: NTIS CSCL 06/19

The cross-sectional geometric properties of ribs 1 through 8 of a medium-framed female cadaver specimen were studied. Specifically, each rib was cut into 10 sections, the exposed cross-sections photographed, a finite element grid superimposed, and with the aid of a digital computer, the geometric properties (total area, compact bone area, centroid, principal axes, principal moments of inertia and torsional constant) of the compact bone region were determined. Although most of these quantities exhibit wide variations some trends do emerge. Of particular significance is a simple geometric construction for the location of the centroid and principal axes and the general result that a thin-walled ellipse is a reasonably accurate model from which the approximate cross-sectional properties may be calculated.
Author (GRA)

N72-30094# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE INTERACTION OF THE COMPONENTS OF THE HUMAN BACK
Gerner A. Olsen (City Coll. of New York) Dec. 1971 30 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740451; AMRL-TR-71-29-Paper-14) Avail: NTIS CSCL 06/5

Much of the difficulty retarding progress in treating malfunctions of the human back, stems from a lack of understanding of the interaction of its various components. This paper would attempt to clarify such interaction and present clinical and experimental evidence supporting its concepts. The actions of the thoracic and lumbar portions of the back are discussed separately. In the thoracic portion lateral stability is shown to be largely dependent on the truss mechanisms resulting from the ribs and attached musculature. The lumbar portion is shown to derive its stability from its inherent spinal components as well as its strong muscular bracing. The result of malfunctions in each of these regions is also emphasized.
Author (GRA)

N72-30095# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE ULTIMATE STRENGTH AND FAILURE MECHANISM OF ANTHROPOID KNEE JOINTS
John O. Outwater (Vermont Univ., Burlington), Carl H. Jacobs (Vermont Univ., Burlington), and Robert W. Castle (Vermont Univ., Burlington) Dec. 1971 17 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740452; AMRL-TR-71-29-Paper-15) Avail: NTIS CSCL 06/19

Testing of the anthropoid knee in three point loading indicates a progressive failure mechanism in an anterior loading situation. This phenomenon is investigated and is shown to be due to the failure of the connective tissue of the knee region as loading progresses. The first response is the patella settling into the intercondyle space of the tibia and contacting the tuberosity. This contact causes the posterior surface of the patella to be bruised. The second response is that of the posterior cruciate ligament failing at its point of insertion into the medial condyle. The ultimate and final failure of the joint occurs when the posterior cruciate ligament completely ruptures and causes the ligament of Wrisberg to tear its lateral condyle insertion allowing the complete collapse of the joint. The relationships between the angular displacement of the knee joint and the applied bending

moment are shown for different size joints. The failure conditions are related also to the joint sizes. The effects of freezing on the angular modulus of the joint and on its ultimate strength is shown to reduce the strength and modulus about 50%.
Author (GRA)

N72-30096# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE EFFECTS OF HYPOGRAVIC AND HYPODYNAMIC ENVIRONMENTS ON THE SKELETAL SYSTEM AND ACCELERATION TOLERANCE
L. E. Kazarian and H. E. VonGierke Dec. 1971 26 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740453; AMRL-TR-71-29-Paper-16) Avail: NTIS CSCL 06/19

The purpose of this study was to determine the effects of disuse atrophy of bone on spinal impact tolerance for the Rhesus monkey. This study clearly demonstrates that disuse and inactivity has profound structural and functional effects on the weight bearing spine, in terms of decreased spinal impact tolerance. The presently used biodynamic injury criteria for impact is based on laboratory experiments and field data, with adult human and animal subjects whose skeletal systems are assumed to be normal and healthy. Disuse atrophy decreases the overall mechanical strength of the skeletal system to such a degree that injury levels for acceleration exposure are significantly altered, for the immobilized Rhesus monkey. There are indications that a similar analogy may hold true for man in space for extended periods of time. If this is true, new acceleration stress indicies predictive of physiological conditions for the astronaut may become necessary. Author (GRA)

N72-30097# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TESTING DYNAMIC MATERIAL PROPERTIES OF BRAIN ARTERIES
G. H. Daly (Washington Univ., Seattle), J. D. Chalupnik (Washington Univ., Seattle), and J. D. Danberg (Washington Univ., Seattle) Dec. 1971 15 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970 Sponsored in part by NIH Head Injury Program
(AF Proj. 1231)
(AD-740454; AMRL-TR-71-29-Paper-17) Avail: NTIS CSCL 06/19

Freshly excised arteries of the brain obtained from human autopsy have been tested under dynamic loading conditions for the purpose of determining a suitable dynamic constitutive relation for the material. The results of these tests are to be used in the construction of improved mathematical and physical biodynamic models of the head for use in the Head Injury Program. Preliminary results show that the arteries display a nonlinear elastic behavior with no frequency dependent viscoelastic effects over the range of frequencies tested or under static loading. Author (GRA)

N72-30098# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
MODELING THE CIRCULATORY SYSTEM UNDER BIODYNAMIC LOADS
Julia T. Apter (Ill. Univ., Chicago) Dec. 1971 22 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740459; AMRL-TR-71-29-Paper-22) Avail: NTIS CSCL 06/19

The model developed here was based on the dynamic viscoelastic properties of the components of the cardiovascular system. The model parameters are functions of time and are valid for a wide range of strains. From some limited kinds of behavior numerical values for model parameters can be obtained from data on intact portions of a human cardiovascular system. Almost all behavior can be clarified with this model which, therefore, serves as a valuable teaching aid and as a basis for evaluating the qualitative results to be expected from management of changes induced by large dynamic loads, like impact.
Author (GRA)

N72-30099# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE TRANSVERSE RESPONSE OF THE LUMBAR SPINE UNDER LONGITUDINAL LOADS
H. E. Krause (Dayton Univ. Res. Inst.) and M. Shirazi (Dayton Univ. Res. Inst.) Dec. 1971 29 p refs Presented at the Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970 Sponsored in part by Dayton Univ. Res. Inst.
(Contract F33615-69-C-1681; AF Proj. 7231)
(AD-740461; AMRL-TR-71-29-Paper-24) Avail: NTIS CSCL 06/19

A novel continuous model of the spine is presented. The transverse motion in the sagittal plane of the spine of sitting human subjects exposed to vertical vibrations revealed considerable bending along the lumbar spine and negligible bending along the thoracic spine. Therefore, the model consists of a curved rod, representing the lumbar spine, longitudinally loaded by a mass, representing the thorax. The differential equation of the transverse motion was derived and solved by making a product assumption. No transverse displacements and no bending moment was assumed at the pelvic end. At the thoracic end, a shear force and a bending moment are applied, representing translatory and rotatory inertia of the attached rib cage. Eigenfunctions and eigenvalues depend on longitudinal loading. The eigenfunctions correlate well with data obtained over a large range of experimental conditions. The solution for the time distribution contains various distinct harmonic components if an external force, alternating sinusoidally at only one discrete frequency, is applied. This effect is due to a periodic parameter in the differential equation. Author (GRA)

N72-30100# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
NONLINEAR LUMPED PARAMETER MATHEMATICAL MODEL OF DYNAMIC RESPONSE OF THE HUMAN BODY
Gordon R. Hopkins (West Virginia Univ.) Dec. 1971 22 p refs Presenter at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740462; AMRL-TR-71-29-Paper-25) Avail: NTIS CSCL 06/19

Two nonlinear models of man's dynamic response to low frequency vibration are discussed. The first model uses linear spring and damper elements but accounts for the nonlinear geometry of visceral mass motion. This model adequately reproduces both the input mechanical impedance and vibration transmission characteristics for a seated human subject. The second model includes the nonlinear effects of the lungs. The influence of this nonlinearity on the dynamic response is discussed and compared to experimental results from tests on animals. Author (GRA)

N72-30101# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
CONTROL OF THE HUMAN FOREARM DURING ABRUPT ACCELERATION
P. A. Stewart (Brown Univ.), J. Duffy (Brown Univ.), J. Soechting (Brown Univ.), H. Litchman (Brown Univ.), and P. R. Paslay (Brown Univ.) Dec. 1971 22 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740463; AMRL-TR-71-29-Paper-26) Avail: NTIS CSCL 06/19

The paper describes research aimed toward the development of a useful mathematical model of the human forearm including the musculature and its neural control. The goals are to provide quantitative bases for both diagnosis and monitoring of therapy

in a variety of neuromuscular disease states, and also to improve current understanding of the basic physiological systems involved. Three types of experiments designed to evaluate the parameters in the model have been performed on human subjects. The first, a series of static tests, demonstrates on the basis of the principles of structural mechanics that averaged electromyogram amplitude is directly related to muscle contractile force. The second experiment, a set of constant velocity tests, independently evaluates these same parameters, as well as a damping coefficient. The results show that damping is small. The third, a series of quick release tests, evaluates the control parameters in the model. Results indicate that velocity control is much less important for present experimental conditions than direct proportional control. Author (GRA)

N72-30102# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

AN APPROACH TO HEAD IMPACT ANALYSIS

Gordon Moskowitz (Drexel Univ.), Joseph Rose (Drexel Univ.), and Stephen Gordon (Drexel Univ.) Dec. 1971 8 p Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740464; AMRL-TR-71-29-Paper-27) Avail: NTIS CSCL 06/19

Presently, many mathematical models of response to head impact are based on a thin elastic shell filled with an inviscid fluid. While these models serve as starting points, anatomic and physiologic considerations indicate that many areas for improvement exist. Research has been recently initiated to determine the behavior of the multi-layered viscoelastic and elastic-plastic brain protection system in response to impact loading. Geometrically simplified layered mathematical models are proposed to evaluate the importance of viscous, plastic, and layering effects within the model. Dynamic material testing has been performed on photoelastic models to demonstrate stress wave propagation through the cavities within the diploe region. Author (GRA)

N72-30103# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

THE BIOMECHANICS OF SPINAL AND HEAD IMPACT: PROBLEMS OF MATHEMATICAL SIMULATION

Y. King Liu (Tulane Univ.) Dec. 1971 37 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740465; AMRL-TR-71-29-Paper-28) Avail: NTIS CSCL 06/19

The paper examines the various mathematical models proposed in impact studies in general and those in connection with spinal and head injuries in particular. First, the concept of injury tolerance surface is introduced. When a complete mapping of this surface is in hand, then the probability of injury due to any acceleration vector can be evaluated. After reviewing a typical single-degree-of-freedom model, a quadrature scheme, based on classical Fourier transform technique, is proposed for obtaining the pulse response from the experimentally determined mechanical impedance. The second part of the paper begins with a review and critique of a promising one-dimensional continuum modzl of head injury by Hayashi. Exact wave-propagation solutions were obtained for the intracranial pressure and container acceleration. The survey of two- or three-dimensional models is divided into axisymmetric, rotational and nonaxisymmetric versions of fluid-filled spherical shells. A brief summary of the implications of the idealizations discussed above to other critical organs of the human body concludes the paper. Author (GRA)

N72-30104# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

THE EFFECT OF VIBRATION ON BLOOD FLOW AND PRESSURE IN THE MAJOR ARTERIES OF DOGS

Richard G. Edwards (Kentucky Univ.), Charles F. Knapp (Kentucky Univ.), Ernest P. McCutcheon (Kentucky Univ.), Karl O. Lange (Kentucky Univ.), and Ward O. Griffen (Kentucky Univ.) Dec. 1971 30 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AF Proj. 7231)

(AD-740466; AMRL-TR-71-29-Paper-29) Avail: NTIS CSCL 06/19

The response of various systems in the human body to forces transmitted from vehicles and machinery has been the object of much research in recent years, but there have been few direct experimental measurements of cardiovascular function in a dynamic environment. This report describes both in vitro and in vivo approaches to analyzing the cardiovascular effects of vibration. First, a simplified mechanical model of the circulatory system was constructed and exposed to sinusoidal vibration. Next, electromagnetic flow transducers were chronically implanted around the aorta and the pulmonary and carotid arteries of a dog. After recovery the animal was anesthetized, placed in an upright position (spine vertical), and vibrated at 2 to 12 Hz and at 1 to 3G acceleration amplitude in the direction of the gravity vector. Variables measured were blood flow rate, arterial pressure, and force transmitted between animal and vibration exciter. The purpose was to determine the maximum and minimum peak flow rates, pressures, and transmitted force during vibration compared to normal levels. Author (GRA)

N72-30105# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

ANALYSIS OF GAIT USING A MINIMUM ENERGY APPROACH

R. E. Beckett and K. C. Pan (US Army Weapons Command) Dec. 1971 20 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970

(AD-740470; AMRL-TR-71-29-Paper-33) Avail: NTIS CSCL 06/19

The paper presents an analysis of the motion of the legs and the center of gravity of the torso in walking. The analysis is based on the hypothesis that the behavior will be such as to minimize the amount of muscle effort and be consistent with constraints imposed by muscle behavior and geometry. The equations of motion are solved by a shooting technique which is made to satisfy conditions imposed at the beginning and end of a step cycle by an interval halving method. Results give the time-phased position of the legs and the torso center of gravity and the moment inputs at the pelvis and the knee. Comparisons of results are made with available experiments and analysis. Results and comparisons are displayed in graphical form. Author (GRA)

N72-30106# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

RESPONSE OF THE SPINE IN BIODYNAMIC ENVIRONMENTS

Mehdi Shirazi (Dayton Univ. Res. Inst.) Dec. 1971 8 p ref Presented at the Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970 Sponsored in part by Dayton Univ. Res. Inst.

(AF Proj. 7231)

(AD-740471; AMRL-TR-71-29-Paper-34) Avail: NTIS CSCL 06/19

The report discusses the propagation of longitudinal elastic waves along the spine considered as a thin uniform rod with nonlinear elastic parameters. The response of the spine in terms of the dynamic longitudinal deformation of the spine cross section is determined and its variation with respect to axial distance and the applied frequency is noted. Author (GRA)

N72-30107# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

A DYNAMIC MODEL OF THE SPINE USING A POROUS ELASTIC MATERIAL

Edmund F. Rybick (Battelle Mem. Inst.) Dec. 1971 26 p refs Presented at the Symp. on Biodyn. Models and their Appl.,

Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740472; AMRL-TR-71-29-Paper-35) Avail: NTIS CSCL 06/19

A preliminary investigation of a two-phase solid-fluid continuum model to represent the spinal column subjected to dynamic loadings is presented. The two-fold purpose of this investigation is: (1) to examine a simple dynamic model that has a continuum representation and offers a capability to include the inertia and pressure effects of a fluid and (2) to use this model to study what effect the presence of a fluid has on the stresses in the solid material. The model consists of a uniform straight porous elastic column containing a viscoelastic fluid and supporting a mass to represent the head. Loading consists of a constant acceleration at the base of the column. Two types of boundary conditions for the fluid at the upper end of the column are considered. The problem is formulated in terms of two coupled partial differential equations with the displacements of the fluid and the solid material treated as unknowns. Author (GRA)

N72-30108# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
A MATHEMATICAL MODEL FOR THE BEHAVIOR OF THE BRAIN WHEN THE HUMAN HEAD IS SUBJECTED TO IMPULSIVE LOADS
Ali E. Engin (Mich. Univ.) and Verne L. Roberts (Mich. Univ.) Dec. 1971 28 p refs Presented at the Symp. on Biodyn. Models and their Appl., Dayton Ohio, 26-28 Oct. 1970
(Contract PH-43-67-1136; AF Proj. 7231)
(AD-740473; AMRL-TR-71-29-Paper-36) Avail: NTIS CSCL 06/19

The subject matter of this paper is concerned with the theoretical determination of the behavior of the brain when the human head is subjected to external impulsive loads. The mathematical analysis is made for the axisymmetric response of an inviscid compressible fluid loaded impulsively by its elastic spherical shell container. In the analysis, first the solution for an initial value problem is obtained. Later the transient response of the fluid for an arbitrary velocity input of the shell is constructed by means of convolution integral. For the numerical results, a characteristic time is defined and the excess pressure distribution in the fluid is evaluated for various deceleration times comparable with this characteristic time. Author (GRA)

N72-30109# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
A MECHANICAL IMPEDANCE MODEL FOR HEAD INJURY DUE TO LINEAR IMPACTS
Richard L. Stalnaker (Michigan Univ.), James H. McElhaney (Michigan Univ.), and Verne L. Roberts (Michigan Univ.) Dec. 1971 28 p refs Presented at Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231; Contracts DOT-FM-11-7288; PH-43-67-1136)
(AD-740474; AMRL-TR-71-29-Paper-37) Avail: NTIS CSCL 06/19

The mechanical impedance of the human and various other primate species heads was determined over the frequency 30-5000 hertz. A simple model was developed that closely follows the observed impedance characteristics. Spring and damping constants were evaluated and comparisons between species obtained. An impact tolerance curve was computed based on the model predictions with a maximum strain criteria. Various input pulse shapes were analyzed and the effect of pulse shape and duration studied for the different species. Published values of tolerable impulses were examined and compared with the model predictions. Author (GRA)

N72-30110# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE BIOLOGICAL RESPONSE OF THE SPINAL CANAL AND ITS CONTENTS TO SURGICAL TRAUMA OF THE AXIAL SKELETON; COMMENTS ON INFRAHUMAN EXPERIMENTATION AND BIOSTATISTICS IN CLINICAL ORTHOPEDICS
John Hartley Moore (Yale Univ.) Dec. 1971 42 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AD-740475; AMRL-TR-71-29-Paper-38) Avail: NTIS CSCL 06/5

The presentation deals with the occurring loads or forces (surgical trauma) applied to the canine intervertebral space and its surrounding structures when a surgeon performs a laminectomy with exploration of an interspace. This may also occur when the human disc space is entered, either purposely for diagnosis, such as discography, or accidentally during the course of spinal anesthesia (rare). GRA

N72-30111# Naval Medical Research Inst., Bethesda, Md.
BIOCHEMICAL STUDIES DURING SATURATION DIVING: A COMPARISON OF A SATURATION DIVE WITH SATURATION-EXCURSION DIVES Medical Research Interim Report
David E. Uddin, Richard E. Danziger, Terry L. Sallee, John M. Alexander, and Edward T. Flynn 12 Oct. 1971 47 p refs
(MF12524014)
(AD-740508; NAVMED-2) Avail: NTIS CSCL 06/19

A number of serum constituents were measured before, during and after one saturation-excursion dive to 300 feet of sea water (FSW), two saturation-excursion dives to 600 FSW, and one saturation dive to 1000 FSW. Significant increases in creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) activity were noted on both saturation-excursion profiles. However, there were essentially no changes in serum enzyme activity during the saturation dive to 1000 FSW. On all 3 profiles, serum lactic acid was elevated with the largest increase occurring on the 1000 FSW dive. No changes were noted in the serum lipid constituents on any of these dives. These changes in serum biochemistries are discussed in relation to the differences in environmental conditions. Author (GRA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering, protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N72-30112*# Stanford Research Inst., Menlo Park, Calif.
SIMULATED INDOOR SONIC BOOMS JUDGED RELATIVE TO NOISE FROM SUBSONIC AIRCRAFT
Karl D. Kryter and Jerome S. Lukas Washington NASA Aug. 1972 20 p refs
(Contract NAS1-10017)
(NASA-CR-2106) Avail: NTIS HC $3.00 CSCL 05E

Judgment tests were conducted in which subjects equated the subjective unwantedness or noisiness of simulated indoor sonic booms with the flyover noise of a subsonic jet aircraft as heard indoors. It was found that the spectral content of the booms, as affected by changes in the rise time of the booms, influenced the relative subjective noisiness of the booms in a way predictable from certain physical measures of Max and EPNL. However, a correction factor is required for predicting from physical measures the subjective noisiness of sonic booms when compared to nonimpulsive subsonic aircraft flyover noise measured in the same physical units. It appears that a somewhat different correction value is required for booms heard outdoors than when heard indoors. Author

N72-30113*# Research Triangle Inst., Durham, N.C.
PRELIMINARY DESIGN STUDY OF A REGENERATIVE LIFE SUPPORT SYSTEM INFORMATION MANAGEMENT AND DISPLAY SYSTEM Final Report
C. D. Parker and J. B. Tommerdahl Apr. 1972 51 p ref

(Contract NAS1-11077)
(NASA-CR-112105) Avail: NTIS HC $4.75 CSCL 06K

The instrumentation requirements for a regenerative life support systems were studied to provide the earliest possible indication of a malfunction that will permit degradation of the environment. Four categories of parameters were investigated: environmental parameters that directly and immediately influence the health and safety of the cabin crew; subsystems' inputs to the cabin that directly maintain the cabin environmental parameters; indications for maintenance or repair; and parameters useful as diagnostic indicators. A data averager concept is introduced which provides a moving average of parameter values that is not influenced by spurious changes, and is convenient for detecting parameter rates of change. A system is included to provide alarms at preselected parameter levels. F.O.S.

N72-30114*# Vought Missiles and Space Co., Dallas, Tex.
ADVANCED EXTRAVEHICULAR PROTECTIVE SYSTEMS (AEPS) STUDY Interim Report, Jul. 1970 - May 1971
James L. Williams, Robert J. Copeland, and Bruce W. Webbon May 1971 77 p refs
(Contract NAS2-6022)
(NASA-CR-114321) Avail: NTIS HC $6.00 CSCL 06K

A description is given of life support subsystem concepts for advanced extravehicular protective systems (AEPS) intended for use on future orbital, lunar surface, and Mars surface missions in the late 1970's and 1980's. Primary interest was centered around the thermal control and carbon dioxide control subsystems because they offer the greatest potential for total weight savings. Emphasis was placed on the generation of regenerable subsystem concepts; however, partially regenerable and expendable concepts were also considered. Previously conceived and developed subsystem concepts were included in the study. Concepts were evaluated on the basis of subsystem weight and volume, and subsystem contribution to parent vehicle weight and volume, which included spares, regeneration equipment, expendables, expandables storage penalty, power penalty, and process heating or cooling penalty. Results are presented showing total weight and volume penalty as a function of total mission extravehicular activity (EVA) hours, and showing EVA weight and volume as a function of EVA duration. Subsystem concepts are recommended for each life support function, and secondary concepts which should be developed are also identified. Author

N72-30115*# Indiana Univ., Bloomington. Div. of Optometry and Program in Physiological Optics.
THE VISUAL STANDARDS FOR THE SELECTION AND RETENTION OF ASTRONAUTS, PART 2
Merrill J. Allen, John R. Levene, and Gordon G. Heath May 1972 29 p refs
(Contract NAS9-9665)
(NASA-CR-115763) Avail: NTIS HC $3.50 CSCL 06N

In preparation for the various studies planned for assessing visual capabilities and tasks in order to set vision standards for astronauts, the following pieces of equipment have been assembled and tested: a spectacle obstruction measuring device, a biometric glare susceptibility tester, a variable vergence amplitude testing device, an eye movement recorder, a lunar illumination simulation chamber, a night myopia testing apparatus, and retinal adaption measuring devices. G.G.

N72-30116*# National Aeronautics and Space Administration, Washington, D.C.
LASER MICROSPECTRAL ANALYSIS OF BIOLOGICAL OBJECTS
G. Dimitrov et al Aug. 1972 13 p refs Transl. into ENGLISH from Godishnik Sofiakiya Univ., Fiz. Fak. (Bulgaria), v. 63, 1968-1969 (published in 1971) p 123-135
(NASA-TT-F-14353) Avail: NTIS HC $3.00 CSCL 20E

The use of the laser microspectral analyzer to study various biological phenomena is discussed. Specific studies include: (1) investigations of links between pigmentation and the presence of metallic components, and their role in the coloration of butterflies; (2) investigations of the distribution of certain inorganic components in the internal and external organs of the common house fly; and (3) investigations of the presence and distribution of metallic components in human hair and teeth. E.H.W.

N72-30117# Civil Aeromedical Inst., Oklahoma City, Okla.
A STUDY OF THE STATE-TRAIT ANXIETY INVENTORY AND THE ASSESSMENT OF STRESS UNDER SIMULATED CONDITIONS
Roger C. Smith May 1972 6 p refs
(FAA-AM-72-23) Avail: NTIS HC $3.00

One approach to the measurement of stress in ATC and other aviation personnel is through assessment of anxiety. One means of accomplishing this is to use the state-trait anxiety inventory (STAI), a 40-item self-report technique. However, the STAI may be susceptible to effects of biasing response sets. In order to determine if stress can be simulated on the STAI, the responses of 283 subjects obtained under normal instructions were compared to their responses obtained when asked to make it appear as if they were experiencing a high degree of stress. It was found that while both the A-State (current anxiety level) and A-Trait (anxiety proneness) scales were influenced by this response set, the effect was greater for the A-State scale. Using the A-State raw score alone as an index of bias resulted in 95.7% accuracy in protocol classification. A two-step procedure, using eight items and the A-State raw score, was subsequently devised which reduced false-positive classifications of legitimate psychiatric patient profiles from 49% to 38% with no reduction in discriminatory power for normal records. The application of the index to clinical and research settings in aviation was discussed. Author

N72-30118# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE EFFECT OF SECONDARY TASKS ON PILOT DESCRIBING FUNCTIONS IN A COMPENSATORY TRACKING TASK
B. L. Watson Jun. 1972 48 p refs
(UTIAS-178) Avail: NTIS HC $4.50

The effect certain secondary tasks have on human pilot describing functions is examined. The describing functions are generated from a compensatory tracking task with rate-control dynamics. The experiment involved six well trained subjects in a multitask situation where the primary control task was tracking. The results are presented as amplitude and phase plots of measured describing functions, which are fitted by an eight-parameter theoretical pilot model. The effects are described in terms of both raw data and model parameters. Author

N72-30119# Joint Publications Research Service, Arlington, Va.
MILITARY HUMAN FACTORS ENGINEERING
G. N. Ageyev 1 Aug. 1972 440 p refs Trasl. into ENGLISH of the book "Voyennaya Inzhenernaya Psikhologiya" Moscow, USSR Ministry of Defense Publishing House, 1970 400 p
(JPRS-56653) Avail: NTIS HC $22.00

Soviet research in the basic science of the interaction of man and machine in modern complex military systems is reported. Problems considered in the military human factors engineering include: psychological structure of military operator activities; modeling psychophysiological functions of man for personnel selection, and designing trainers; and special directions which reflect the interests of different types of armed forces and branches of arms. F.O.S.

N72-30120# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Advanced Systems Div.
DESIGN OPTION DECISION TREES. A METHOD FOR RELATING HUMAN RESOURCES DATA TO DESIGN ALTERNATIVES Technical Report, Jan. - Oct. 1971
William B. Askren and Kenneth D. Korkan (System Research Labs., Inc.) Dec. 1971 34 p refs
(AF Proj. 1124)

(AD-741768; AFHRL-TR-71-52) Avail: NTIS CSCL 05/5

The feasibility of predetermining the design options available to the engineer during system design and placing the results in a decision tree format was investigated. Design option decision trees for propulsion and flight control subsystems were developed. The decision trees were evaluated by eight engineers experienced in designing these specialized areas of aerospace systems. It is concluded that the decision format is a feasible and valid method for describing system design options. It is hypothesized that design option decision trees may provide a means for relating human resources data to specific design characteristics. However, a number of additional investigations are needed to develop and validate a workable technique for using DODT's as a method for including human resources data in design decisions. Author (GRA)

N72-30121# Denver Univ., Colo. Dept. of Mechanical Sciences and Environmental Engineering.

ANALYTICAL AND EXPERIMENTAL EVALUATION OF A PILOT CHIN-AIRBAG SYSTEM

Arthur A. Ezra Apr. 1972 84 p refs

(Contract N00014-67-A-0394-003)

(AD-742449) Avail: NTIS CSCL 06/17

The research reported has been directed toward the development of an inflatable collar for pilots. The collar is designed to protect the head against violent rotation and against loss of consciousness during survivable crashes of aircraft. Analytical studies were conducted to determine the range of effectiveness of an airbag for use as a collar in reducing the peak deceleration of the head in a crash. The goal is to arrive at the best possible design and performance criteria for such an airbag. Author (GRA)

N72-30122# Webb Associates, Yellow Springs, Ohio.

HUMAN FORCE EXERTIONS IN AIRCRAFT CONTROL LOCATIONS

Marvin L. Thordsen, K. H. Eberhard Kroemer (AMRL), and Lloyd L. Laubach Wright-Patterson AFB, Ohio AMRL Feb. 1972 84 p refs

(Contract F33615-71-C-1087; AF Proj. 7184)

(AD-740930; AMRL-TR-71-119) Avail: NTIS CSCL 01/3

Experiments were conducted to measure the maximum isometric forces male subjects could exert at six locations of hand-operated aircraft controls. Forces were measured in two vertical and four to eight horizontal directions. The subject (n=51) sat in a simulated aircraft seat and exerted forces on a cylindrical handle. Selected anthropometric dimensions were obtained on the subjects and compared with those from the 1967 USAF anthropometric survey of flying personnel. Summary statistics, including the mean, standard error of the mean, standard deviation, standard error of the standard deviation, coefficient of variation, symmetry, kurtosis, and selected percentiles, are presented for each of the 44 force exertion measures. Author (GRA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N72-30123# Bureau of Mines, Morgantown, W.Va.

BUREAU OF MINES ENERGY PROGRAM, 1971

John D. Spencer and Bill Linville 1972 109 p refs

(BM-IC-8551) Avail: NTIS HC $7.50

In 1971 increase emphasis was placed on the production of fluid fuels and chemicals from coal. Advances were achieved in the development of the Synthane and Hydrane gasification processes for producing pipeline gas from coal, and progress was made in research on solid wastes utilization, and on liquid fuels production from coal. Coal mine safety, solid waste disposal and utilization, coal preparation and transport, and fundamental research on coal and related products also continued to be the subject of extensive research. Improved methods for extracting petroleum and natural gas without surface and subsurface pollution are discussed. This research was highlighted by studies of the fracturing systems of reservoir rocks, including subsurface fracture mapping and fracturing techniques to achieve optimum production of oil and gas. Oil recovery by water or gas flooding, by steam injection, on the identification of oil spills, and on means to reduce vehicular exhaust emissions is summarized. Author

N72-30124*# National Aeronautics and Space Administration, Washington, D.C.

THE MECHANISM OF THE ELECTRODIFFUSION OF HYDROGEN THROUGH PALLADIUM

N. I. Kobozev and V. V. Monblanova Aug. 1972 39 p refs Transl. into ENGLISH from Acta Physiochim. (USSR), v. 1, no. 3-4 1934, p 611-650

(NASA-TT-F-14368) Avail: NTIS HC $4.00 CSCL 07D

Hydrogen diffusion onto palladium electrodes, activity of poisoning catalysts, electrolytic effects, and rates of diffusion are discussed. It was found that location of diffusion centers along the crystalline lattices helps explain the acceleration caused by poisons on the polarization side of the membrane. The relationships of the diffusion mechanism tend to be linear. Author

N72-30125*# Scientific Translation Service, Santa Barbara, Calif.

RADIONUCLIDE X-RAY FLUORESCENCE ANALYSIS. 1: EXCITATION OF X-RAY FLUORESCENSE RADIATION BY NUCLEAR RADIATION

S. Varga Washington NASA Aug. 1972 20 p refs Transl. into ENGLISH from Chem. Listy (Prague), v. 64, no. 12, 1970 p 1253-1265

(Contract NASw-2035)

(NASA-TT-F-14510) Avail: NTIS HC $3.00 CSCL 20L

The principles of radionuclide excitation of X-ray fluorescence radiation and its application in analytic chemistry are discussed. Excitation principles of X-ray fluorescence radiation by radionuclide nuclear radiation are described. Author

N72-30126*# Union Carbide Corp., Oak Ridge, Tenn.

FLUORINE GAS AS A CLEANING AGENT FOR APOLLO BULK-SAMPLE CONTAINERS

R. H. Liddle, J. M. McIntyre, and C. E. McAlister 8 Mar. 1972 22 p Sponsored in part by NASA

(Contract W-7405-eng-26)

(NASA-CR-127821; Y-1809) Avail: NTIS HC $3.00 CSCL 07D

A technique has been developed for cleaning Apollo bulk sample containers using fluorine gas as the cleaning agent. Author

N72-30127*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

POTASSIUM PERMANGANATE FOR MERCURY VAPOR ENVIRONMENTAL CONTROL

David E. Kuivinen Washington Sep. 1972 16 p refs

(NASA-TM-X-2616; E-6929) Avail: NTIS HC $3.00 CSCL 07D

Potassium permanganate (KMnO4) was evaluated for application in removing mercury vapor from exhaust air systems. The KMnO4 may be used in water solution with a liquid spray scrubber system or as a solid adsorber bed material when impregnated onto a zeolite. Air samples contaminated with as much as 112 mg/cu m of mercury were scrubbed to 0.06 mg/cu m with the KMnO4-impregnated zeolite (molecular sieve material). The water spray solution of permanganate was also found to be as effective as the impregnated zeolite. The KMnO4-impregnated zeolite was applied as a solid adsorber

material to (1) a hardware decontamination system, (2) a model incinerator, and (3) a high vacuum chamber for ion engine testing with mercury as the propellant. A liquid scrubber system was also applied in an incinerator system. Based on the results of these experiments, it is concluded that the use of KMnO4 can be an effective method for controlling noxious mercury vapor.
Author

N72-30128*# Southwest Research Inst., San Antonio, Tex.
A STUDY OF VOLATILE CONTAMINANTS IN RECOVERED WATER
Herbert C. McKee and Rudy Marek, Jr. May 1972 23 p
(Contract NAS9-11580)
(NASA-CR-115755; TR-1) Avail: NTIS HC $3.25 CSCL 07D

The recovery and reuse of water during long term space flight is discussed. Particular attention was given to obtaining basic information on the volatile impurities in urine samples and in water recovered from urine by distillation. Data also cover laboratory distillation tests to determine the nature and extent of volatile constituents in the distillate and an evaluation of possible problems in distillation due to iodine used for control of microbial contamination. Efforts made to develop design criteria for distillation equipment to minimize the problems of volatile contaminants various methods which might be used for purification subsequent to recovery are included.
Author

N72-30129*# Pittsburgh Univ., Pa. Space Research Coordination Center.
MOBILITIES OF URANIUM AND MERCURY IONS IN HELIUM
R. Johnsen and Manfred A. Biondi Aug. 1972 16 p refs Submitted for publication
(Grant NGR-39-011-002; Contract DA-31-124-ARO(D)-440; ARPA Order 826)
(NASA-CR-128026; APP-35; SRCC-177) Avail: NTIS HC $3.00 CSCL 07D

The mobilities of mass-identified U(+) and Hg (+) ions in helium were determined in a drift tube-mass spectrometer. For uranium ions, a reduced mobility value is obtained at 305 K and a standard gas density of 2.69 x 10 to the 19th power/cu cm. The mobility of mercury ions is in agreement with two previous determinations. The effect of fast ion injection in drift mobility measurements is discussed, and a technique to circumvent these problems is described. The results are compared with existing theories of ion mobilities.
Author

N72-30130*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHEMICAL EVOLUTION OF DENSE CLOUDS
E. W. Chappelle, B. D. Donn, W. A. Payne, Jr., and L. J. Stief Sep. 1972 17 p refs Submitted for publication
(NASA-TM-X-66008; X-691-72-321) Avail: NTIS HC $3.00 CSCL 07D

Chemical processes that could determine the molecular composition of the cloud during the several stages of its evolution are considered. Reactions at the relatively interstellar densities are emphasized.
Author

N72-30131*# Idaho Univ., Moscow. Dept. of Mechanical Engineering.
AN EQUATION OF STATE FOR OXYGEN AND NITROGEN 2 Quarterly Progress Report, period ending 1 Jan. 1972
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 1 Jan. 1972 52 p refs
(Contract NAS9-12078)
(NASA-CR-128523) Avail: NTIS HC $4.75 CSCL 07D

Preliminary equations of state for oxygen and nitrogen are presented which are the result of least squares fitting of the available P-density-T data, heat capacities at constant volume, and data to establish the criteria for phase equilibrium, simultaneously. The equation for nitrogen is applicable to 10,000 atmospheres at temperatures from 70 K to 1300 K, and the equation for oxygen to 350 atmospheres for temperatures from 56 K to 323 K. The development of the functional form of the equation of state, data weighting methods, and the techniques employed for least squares fitting of related data are discussed. Comparisons of the equation of state developed with selected values of experimental P-density-T data, and heat capacity values are included for both fluids.
Author

N72-30132*# Idaho Univ., Moscow. Dept. of Mechanical Engineering.
THERMODYNAMIC PROPERTIES OF OXYGEN AND NITROGEN III Quarterly Progress Report, period ending 1 Apr. 1972
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 1 Apr. 1972 36 p refs
(Contract NAS9-12078)
(NASA-CR-128524) Avail: NTIS HC $4.00 CSCL 07D

The final equation for nitrogen was determined. In the work on the equation of state for nitrogen, coefficients were determined by constraining the critical point to selected critical point parameters. Comparisons of this equation with all the P-density-T data were made, as well as comparisons to all other thermodynamic data reported in the literature. The extrapolation of the equation of state was studied for vapor to higher temperatures and lower temperatures, and for the liquid surface to the saturated liquid and the fusion lines. A new vapor pressure equation was also determined which was constrained to the same critical temperature, pressure, and slope (dP/dT) as the equation of state. Work on the equation of state for oxygen included studies for improving the equation at the critical point. Comparisons of velocity of sound data for oxygen were also made between values calculated with a preliminary equation of state and experimental data. Functions for the calculation of the derived thermodynamic properties using the equation of state are given, together with the derivative and integral functions for the calculation of the thermodynamic properties using the equations of state. Summary tables of the thermodynamic properties of nitrogen and oxygen are also included to serve as a check for those preparing computer programs using the equations of state.
Author

N72-30133*# Idaho Univ., Moscow. Dept. of Mechanical Engineering.
AN EQUATION OF STATE FOR OXYGEN AND NITROGEN Quarterly Progress Report, period ending 1 Oct. 1971
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 1 Oct. 1971 58 p refs
(Contract NAS9-12078)
(NASA-CR-128522; RR-13) Avail: NTIS HC $5.00 CSCL 07D

Preliminary equations of state are presented for oxygen and nitrogen which provide accurate representations of the available P-density-T data for both fluids. The equation for nitrogen is applicable for temperatures from 70 K to 1300 K at pressures to 10,000 atmospheres, and the equation for oxygen for temperatures from 70 K to 323 K at pressures to 350 atmospheres. Deviations of calculated densities from representative experimental data are included. A volume-explicit equation of state for oxygen to be used in estimating density values in the range of applicability of the equation of state is also presented.
Author

N72-30134# Purdue Univ., Lafayette, Ind. School of Materials Science and Metallurgical Engineering.
DIFFUSION AND PRECIPITATION OF INERT GASES IN METALS Technical Progress Report, 1 Jun. 1971 - 28 Feb. 1972
James R. Cost 28 Feb. 1972 6 p
(Contract AT(11-1)-1799)
(COO-1799-9) Avail: NTIS

Studies on the Al-He and Nb-He systems are reported. It was found that bubble coalescence in the Nb-He system was in agreement with that for the Al-He system, except that coalescence

appeared to be even more difficult. The goal of characterizing the process of bubble nucleation in the Al-He system was found to be elusive. An approach for studying early precipitation is described. Studies on bubble mobility and coalescence in Al-He showed that coalescence occurs more rapidly for small bubbles, and it then reaches an equilibrium size, not unlike grain growth, at which growth is very slow. Measurement of the variation of the bubble size distribution with annealing time was in best agreement with the facet nucleation-limited diffusion model.
Author (NSA)

N72-30135# European Space Research Inst., Frascati (Italy).
THE ABSORPTION SPECTRUM OF Hg I BETWEEN 370 AND 900 A
M. W. D. Mansfield [1972] 25 p refs Submitted for publication Sponsored by Sci. Res. Council
Avail: NTIS HC $3.25

The atomic absorption spectrum of Hg I between 370 and 900 A was photographed. Measurements and analysis of the 5d10 6s2(1S0) - 5d9 6s2 np, nf series between 743 and 950 A are confirmed and extended slightly. In addition, at least 76 features between 500 and 800 A are reported and ascribed.
Author (ESRO)

N72-30136# California Inst. of Tech., Pasadena.
AN EXPERIMENTAL INVESTIGATION OF PARTICLE MOTION IN A LIQUID FLUIDIZED BED Final Report, 1 Jan. 1968 - 1 Aug. 1970
Charles A. Willus Jan. 1972 133 p refs
(Contract F33615-69-C-1069; AF Proj. 7116)
(AD-741779; ARL-72-0018) Avail: NTIS CSCL 07/1

A laboratory study was made on particle motion in liquid fluidized beds. Experiments made in a bed of 4-inch inside diameter with a large length-to-diameter ratio of 24 to 1 are described. Particle motion in the bed was found to be essentially a diffusion process. Diffusion coefficients for motion in the vertical direction were measured for glass beads of .236-inch diameter at a range of average bead concentrations. Vertical diffusion was independent of radial position in the bed. The experimental findings on particle diffusion in the bed were compared to principles of diffusion of a turbulent fluid. Steady and quasi-steady patterns of particle circulation were observed in both a cylindrical bed with a length-to-diameter ratio of 5 to 1 and in beds of conical shape, and are described. Author (GRA)

N72-30137# Syracuse Univ., N.Y. Dept. of Chemistry.
POLYMERS WITH ANTHRAZOLINE UNITS IN THE MAIN CHAIN Final Report, 1 Mar. 1969 - 28 Feb. 1971
William Bracke and Paul M. Caluwe 20 Feb. 1970 32 p refs
(Contract F19628-69-C-0209; AF Proj. 8659)
(AD-741774; AFCRL-72-0132) Avail: NTIS CSCL 07/3

The Friedlander quinoline synthesis was applied to 4,6-diaminoisophthaldehyde. This compound was condensed with acetophenone, 2-acetylpyridine, 4-acetyldiphenylether and phenylacetaldehyde yielding the corresponding anthrazolines (Pyrido(2,3-g)quinolines). These model reactions were then applied to the polycondensation of 4,6-diaminoisophthaldehyde with p-diacetylbenzene, 2,6-diacetylpyridine and bis(p-acetylphenyl) ether. The resulting polymers have a high thermal stability as revealed by thermogravimetric analysis (620 C break under nitrogen). The extension of the Friedlander quinoline synthesis in the pyridine series was investigated, resulting in new syntheses for 2-amino-3-formylpyridine and 2,6-diamino-3,5-diformylpyridine. Author (GRA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N72-30138 National Lending Library for Science and Technology, Boston Spa (England).
SOME CONSIDERATIONS ON CROSSTALK COUPLING LOSS OF MULTIPAIR BALANCED TYPE CABLE FOR TV TRANSMISSION
Sumio Nakayoshi, Masasane Yotsuya, Masaki Minematsu, Hideaki Nishimura, and Tsutomu Shimizu 30 Mar. 1972 12 p refs Transl. into ENGLISH from Dainichi Nippon Cables rev. (Japan), no. 49, Jul. 1971 p 7-13
(NLL-Trans-2828-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.

A method is discussed of estimating the worst values for crosstalk attenuation and effective crosstalk attenuation upon hypothesizing the gamma distribution of crosstalk voltage ratio. In addition an additive feature of crosstalk is observed and empirical equations are derived for estimating the form of distribution of crosstalk attenuation in a random length of a cable from the results of observations. Author

N72-30139*# Ohio State Univ., Columbus. Electroscience Lab.
MILLIMETER-WAVELENGTHS PROPAGATION STUDIES Semiannual Status Report, Nov. 1971 - Apr. 1972
D. B. Hodge and L. R. Zintsmaster May 1972 35 p refs
(Grant NGR-36-008-080)
(NASA-CR-122452; SASR-2374-9) Avail: NTIS HC $3.75 CSCL 20N

The various meteorological parameters that influence millimeter wavelength satellite-to-ground space diversity links are summarized. Space diversity propagation statistics obtained using the 15.3 GHz down-link on ATS-5 are presented. The radiometric temperature as well as attenuation of the satellite signal was recorded for correlation purposes. Both statistics of individual storm events and cumulative statistics have been analyzed yielding single site and joint fade distributions, correlation between attenuation experienced at the two receiving terminals, and correlation between path radiometric temperatures observed at the two receiving terminals. These data indicate that the use of space diversity is indeed effective in improving the reliability of millimeter wavelength satellite-to-ground communication links.
Author

N72-30140*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SPACE STATION HIGH GAIN ANTENNA CONCEPT DEFINITION AND TECHNOLOGY DEVELOPMENT Final Report, 16 Jun. 1971 - 16 Jun. 1972
W. D. Wade 1972 210 p refs
(Contract NAS9-11874)
(NASA-CR-115759; LMSC/D156878) Avail: NTIS HC $12.50 CSCL 09E

The layout of a technology base is reported from which a mechanically gimballed, directional antenna can be developed to support a manned space station proposed for the late 1970's. The effort includes the concept definition for the antenna assembly, an evaluation of available technology, the design of critical subassemblies and the design of critical subassembly tests. Author

N72-30141*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EARTH-SATELLITE PROPAGATION ABOVE GHz: PAPERS FROM THE 1972 SPRING URSI SESSION ON EXPERI-

MENTS UTILIZING THE ATS-5 SATELLITE
Louis J. Ippolito, comp. May 1972 131 p refs Conf. held at Washington, D. C., Apr. 1972
(NASA-TM-X-65990; X-751-72-208) Avail: NTIS HC $8.75 CSCL 17B

Papers are reported from the Special Session on Earth-Satellite Propagation Above 10 GHz, presented at The 1972 Spring Meeting of the United States National Committee, International Union of Radio Science, April 1972, Washington, D. C. This session was devoted to propagation measurements associated with the Applications Technology Satellite (ATS-5), which provided the first operational earth-space links at frequencies above 15 GHz. A comprehensive summary is presented of the major results of the ATS-5 experiment measurements and related radiometric, radar and meteorological studies. The papers are organized around seven selected areas of interest, with the results of the various investigators combined into a single paper presented by a principal author for that area. A comprehensive report is provided on the results of the ATS-5 satellite to earth transmissions. A complete list of published reports and presentations related to the ATS-5 Millimeter Wave Experiment is included. Author

N72-30142*# New Mexico State Univ., University Park. Engineering Environment Station.
ADVANCED STUDY OF VIDEO SIGNAL PROCESSING IN LOW SIGNAL TO NOISE ENVIRONMENTS Semiannual Progress Report, Jun. - Nov. 1971
Frank Garden and Alton Gilbert Nov. 1971 18 p refs
(Grant NGR-32-003-037)
(NASA-CR-115769) Avail: NTIS HC $3.00 CSCL 17B

A generalized mathematical and computer model of the revised Apollo television system was developed and used to determine spectral compatibility with the overall Apollo communication system. In particular the effects of the change to commercial television format from slow-scan black and white on the principal telemetering subcarriers was analyzed. Experimental data was obtained from MSC telemetry division confirming the analytical results. Author

N72-30143*# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
MICROWAVE EMISSION FROM THE MOON
Duane O. Muhleman 1971 33 p refs Submitted for publication
(Grant NGR-005-002-114; Contract N00014-67-A-0094-0019; Grant NSF GP-30400-X)
(NASA-CR-127822; AD-734375; Rept-1971-14) Avail: NTIS HC $3.75 CSCL 03/2

Measurements of the microwave emission from the moon and their interpretation in terms of the thermophysics of that body are reviewed. Variations of the brightness temperatures of the moon during a lunation and during eclipses when combined with infrared and radar measurements yield a precise set of physical parameters for the upper few meters of the lunar soil. These parameters include the density, thermal conductivity, dielectric constant, radio absorption coefficients, and the mean temperature gradiant. Author

N72-30144# National Aviation Facilities Experimental Center, Atlantic City, N.J.
A MAGNETIC TAPE STUDY Final Report, Jul. 1970 - Apr. 1972
Richard Piech Aug. 1972 11 p
(FAA Proj. 121-A11-000)
(FAA-RD-72-66; FAA-NA-72-43) Avail: NTIS HC $3.00

A study was conducted to identify problem areas in the use and handling of magnetic tapes. The study included determining the causes of tape errors and whether it is advantageous to recondition tapes on a periodic basis. An engineering investigation also was conducted to select the optimum equipment for a magnetic tape maintenance program. Author

N72-30145*# Radio Corp. of America, Camden, N.J. Government Communications Systems.
MULTI-EVA COMMUNICATIONS SYSTEM ANALYSIS Final Report
30 Jun. 1972 216 p
(Contract NAS9-12092)
(NASA-CR-115766) Avail: NTIS HC $13.00 CSCL 17B

A communications concept is analyzed to establish requirements of a confident candidate system for space shuttle. Conceptual baseline configurations, EVA's-to-spacecraft via PCM/FDM and spacecraft-to-EVA via PAM/FM, and respective functional performance requirements are discussed. The baseline system is analyzed to determine link characteristics, EMI levels at various frequency bands, and determination of desirable spectrum. Selected L- and S-Band links are analyzed to ascertain signal design parameters. A trade-off is performed, which establishes L-Band frequency as the best compromise. The results of the analysis along with the reliability/safety aspects and physical characteristics of the candidate system, indicate that the initial baseline concept meets functional requirements, but is poor from standpoint of overall space shuttle program cost. Author

N72-30146*# IIT Research Inst., Chicago, Ill.
DESIGN STUDY FOR A HIGH RELIABILITY FIVE-YEAR SPACECRAFT TAPE TRANSPORT Final Report
G. S. L. Benn and R. L. Eshleman Nov. 1971 235 p refs
(Contract NAS5-21556; IITRI Proj. E6179)
(NASA-CR-122453) Avail: NTIS HC $13.75 CSCL 14C

Following the establishment of the overall transport concept, a study of all of the life limiting constraints associated with the transport were analyzed using modeling techniques. These design techniques included: (1) a response analysis from which the performance of the transport could be determined under operating conditions for a variety of conceptual variations both in a new and aged condition; (2) an analysis of a double cone guidance technique which yielded an optimum design for maximum guidance with minimum tape degradation; (3) an analysis of the tape pack design to eliminate spoking caused by negative tangential stress within the pack; (4) an evaluation of the stress levels experienced by the magnetic tape throughout the system; (5) a general review of the bearing and lubrication technology as applied to satellite recorders and hence the recommendation for using standard load carrying antifriction ball bearings; and (6) a kinetic analysis to determine the change in kinetic properties of the transport during operation. Author

N72-30147*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
A NUMERICAL STUDY OF ELECTROMAGNETIC SCATTERING FROM OCEAN LIKE SURFACES
R. R. Lentz Washington NASA Jul. 1972 139 p refs
(Contract NAS1-9998)
(NASA-CR-2091; Rept-3030-1) Avail: NTIS HC $3.00 CSCL 20N

The integral equations describing electromagnetic scattering from one dimensional conducting surfaces are formulated and numerical results are presented. The results are compared with those obtained using approximate methods such as physical optics, geometrical optics, and perturbation theory. The integral equation solutions show that the surface radius of curvature must be greater than 2.5 wavelengths for either the physical optics or geometric optics to give satisfactory results. It has also been shown that perturbation theory agrees with the exact fields as long as the root mean square surface roughness is less than one-tenth of a wavelength. Author

N72-30148*# Systems Associates, Inc., Long Beach, Calif.
ADVANCED COMMUNICATION SYSTEM TIME DOMAIN MODELING TECHNIQUES ASYSTD SOFTWARE DESCRIPTION. VOLUME 1: PROGRAM USERS GUIDE
Aug. 1972 168 p refs 2 Vol.
(Contract NAS9-11743)

(NASA-CR-128516; R72-001-Vol-1) Avail: NTIS HC $10.50 CSCL 17B

A computer program is described which is primarily designed to simulate the transient behavior of communications systems. Author

N72-30149*# Systems Associates, Inc., Long Beach, Calif.
ADVANCED COMMUNICATION SYSTEM TIME DOMAIN MODELING TECHNIQUES ASYSTD SOFTWARE DESCRIPTION. VOLUME 2: PROGRAM SUPPORT DOCUMENTATION
Aug. 1972 70 p
(Contract NAS9-11743)
(NASA-CR-128517; R72-001-Vol-2) Avail: NTIS HC $5.50 CSCL 17B

The theoretical basis for the ASYSTD program is discussed in detail. In addition, the extensive bibliography given in this document illustrates some of the extensive work accomplished in the area of time domain simulation. Additions have been in the areas of modeling and language program enhancements, orthogonal transform modeling, error analysis, general filter models, BER measurements, etc. Several models have been developed which utilize the COMSAT generated orthogonal transform algorithms. Author

N72-30150*# Hughes Aircraft Co., Culver City, Calif.
COMMUNICATIONS TERMINAL BREADBOARD Final Report
Jul. 1972 37 p refs
(Contract NAS9-12019)
(NASA-CR-128515) Avail: NTIS HC $4.00 CSCL 17B

A baseline design is presented of a digital communications link between an advanced manned spacecraft (AMS) and an earth terminal via an Intelsat 4 type communications satellite used as a geosynchronous orbiting relay station. The fabrication, integration, and testing of terminal elements at each end of the link are discussed. In the baseline link design, the information carrying capacity of the link was estimated for both the forward direction (earth terminal to AMS) and the return direction, based upon orbital geometry, relay satellite characteristics, terminal characteristics, and the improvement that can be achieved by the use of convolutional coding/Viterbi decoding techniques. Author

N72-30151# Joint Publications Research Service, Arlington, Va.
WAVEGUIDE TRANSMISSION OF VIDEO-INFORMATION IN COHERENT LIGHT
A. T. Semenov and V. S. Shildyayev 17 Aug. 1972 9 p refs Transl. into ENGLISH from Kvantovaya Elektron. (Moscow), no. 3, 1971 p 42-47
(JPRS-56803) Avail: NTIS HC $3.00

Using an approximation of geometric optics, the distribution of the field of paraxially excited coherent light in flat and rectangular multiple-mode waveguides is considered. The possibility for transmitting a complex optical image through a rectangular waveguide is tested experimentally. Dissipation of radiation energy caused by losses upon multiple reflection is evaluated. Author

N72-30152# Joint Publications Research Service, Arlington, Va.
WIDEBAND WAVEGUIDE Y-CIRCULATORS
I. N. Mukhtarov and V. T. Nilovskiy 16 Aug. 1972 12 p refs Transl. into ENGLISH from Antenny (Moscow), no. 10, 1971 p 74-81
(JPRS-56784) Avail: NTIS $3.00

A method is described for an expansion of the working frequency band of a waveguide H-plane, Y-circulator made with a dielectric bushing placed on a ferrite cylinder. A Y-circulator in a centimeter range of wavelengths adjusted with this method has a working frequency band of 30 percent. The results of the experimental adjustment of a waveguide H-plane T-circulator with the same band is also discussed. Author

N72-30153# Joint Publications Research Service, Arlington, Va.
CROSS POLARIZED RADIATION OF CONVEX SPHERICAL ANTENNAS WITH COUNTERPHASE FIELD DISTRIBUTION
A. Yu. Grinev 11 Aug. 1972 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (Kiev), v. 15, no. 3, 1972 p 308-314
(JPRS-56743) Avail: NTIS HC $3.00

The radiation field of a convex spherical antenna, forming a difference diagram with maximum value of the steepness in the equisignal direction, is investigated. It is demonstrated that the presence of a cross polarized component may lead to a deterioration of the accuracy characteristics of the type of antennas under consideration. Author

N72-30154*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON BACKSCATTER FROM SPATIALLY VARYING SURFACES
Norman C. Grody Aug. 1972 16 p refs Submitted for publication
(NASA-TM-X-66010; X-733-72-311) Avail: NTIS HC $3.00 CSCL 17I

The theory of radar backscatter from rough (spatially varying) surfaces is discussed. An integral equation developed to describe the radar backscatter from a perfectly conducting surface is applied to nonsmooth surfaces. The results are compared with those obtained by Beckmann as well as those obtained by Wright. Differences between the three solutions are discussed. Author

N72-30155# British Aircraft Corp. (Operating) Ltd., Bristol (England). Guided Weapons Technical Publications Dept.
EUROPEAN COMMUNICATION SATELLITE (ECS) TV ADAPTATION STUDY. VOLUME 1: SUMMARY Final Report
Mar. 1972 38 p 2 Vol.
(Contract ESTEC-1468/71)
(ESS/SS-335-Vol-1; ESRO-CR(P)-112) Avail: NTIS HC $4.00

The requirements for adapting the European Communications Satellite (ECS) to a television broadcast satellite are outlined together with the satellite configuration, communications package, and thermal and attitude control systems. Copious tables are provided. ESRO

N72-30156# British Aircraft Corp. (Operating) Ltd., Bristol (England). Guided Weapons Technical Publications Dept.
EUROPEAN COMMUNICATION SATELLITE (ECS) TV ADAPTION STUDY. VOLUME 2: COMMUNITY TV BROADCAST SATELLITE Final Report
Mar. 1972 243 p 2 Vol.
(Contract ESTEC-1468/71)
(ESS/SS-335-Vol-2; ESRO-CR(P)-113) Avail: NTIS HC $14.25

The requirements and configuration for the European Community TV broadcast satellite are outlined together with a review of the mission analyses. The satellite subsystems are described in detail. These include the communications package (antennas and repeaters), thermal control, attitude and orbit control, and the power system. ESRO

N72-30157# British Aircraft Corp. (Operating) Ltd., Bristol (England). Guided Weapons Technical Publications Dept.
EUROPEAN COMMUNICATION STATELLITE (ECS) TV ADAPTATION STUDY. VOLUME 3: INDIVIDUAL TV BROADCAST SATELLITE Final Report
Mar. 1972 250 p 3 Vol.
(Contract ESTEC-1468/71)
(ESS/SS-335-Vol-3; ESRO-CR(P)-114) Avail: NTIS HC $14.50

The requirements and configuration of the European individual TV broadcast satellite are outlined together with a review of the mission analyses. The satellite subsystems are described. These include the communication package (antennas and repeaters), thermal control, attitude and orbit control, and the power system. ESRO

N72-30158# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.

METHODS OF EVALUATING THE INFLUENCE OF SPACECRAFT STRUCTURES ON ANTENNA RADIATION PATTERNS. A FEASIBILITY STUDY

N. C. Albertsen, P. L. Christiansen, J. E. Hansen, and N. Eilskov Jensen Paris ESRO Apr. 1972 104 p refs
(Contract ESTEC-1031/70)
(ESRO-CR-51) Avail: NTIS HC $7.25

A study has been carried out concerning the feasibility of a number of methods for computing the radiation pattern of antennas mounted on complex satellite bodies equipped with experiment-carrying booms and solar-cell panels. The study includes numerical methods for use when the satellite dimensions are not large compared to the wavelength and optical methods for use when the satellite dimensions are large compared to the wavelength. It is concluded that of the numerical methods a combination of magnetic and electric field integral equations with wire-grid modelling is to be preferred. Of the optical methods, geometrical optics together with its extension by the geometrical theory of diffraction is well suited. Author (ESRO)

N72-30159# Washington Univ., St. Louis, Mo. Control Systems Science and Engineering.

PHASE AND FREQUENCY TRACKING ACCURACY IN DIRECT-DETECTION OPTICAL-COMMUNICATION SYSTEMS Interim Report

Donald L. Synder and Ian B. Rhodes 14 Mar. 1972 15 p refs
(Contract F44620-69-C-0116; Grants NSF GK-32239; RR-00396; AF Proj. 9749)
(AD-741915; CSSE-734; AFOSR-72-1045TR) Avail: NTIS CSCL 17/2

Lower bounds are given on the attainable mean-square performance in causally tracking the phase and frequency of a subcarrier that modulates an optical carrier in a direct-detection optical-communication system. Author (GRA)

N72-30160# White Sands Missile Range, N.Mex.

INVESTIGATION OF A PAM TESTER USING PN WAVEFORMS Final Report

Wade C. McClellan and M. H. Nichols Apr. 1972 26 p refs
(DA Proj. 1U2-65302-D-240)
(AD-742262; STEWS-ID-I-72-3) Avail: NTIS CSCL 09/6

A PAM tester using a shift register generated sequence and a conventional data (PCM) bit synchronizer and detector for synchronization was investigated. It was found to function satisfactorily with and without predetection tape recording. This tester can be implemented by adding digital-to-analog converters (DAC's), an error gate, and a rms voltmeter to a PN PCM tester which uses a shift register to generate the PN sequence.
Author (GRA)

N72-30161# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.

MODAL ANALYSIS OF LOADED N-PORT SCATTERERS

Roger F. Harrington and Joseph R. Mautz Mar. 1972 119 p refs
(Contract F19628-68-C-0180; AF Proj. 5635)
(AD-741809; SR-16; AFCRL-72-0179) Avail: NTIS CSCL 20/14

An N-port loaded scatterer is one having N ports to which lumped impedance loads or a load network is connected. Methods are given to determine the characteristic modes of a loaded scatterer and for using them in a modal solution for electromagnetic scattering. A procedure is also given for resonating any given real port current, which makes that current the dominant mode of the loaded scatterer. The theory is formulated both in terms of open-circuit and short-circuit network parameters. A number of numerical examples are given for a wire triangle to illustrate the general theory. Computer programs are included for all procedures discussed.
Author (GRA)

N72-30162# Massachusetts Univ., Amherst. Dept. of Electrical Engineering.

ESTIMATION FOR CYCLOSTATIONARY RANDOM PROCESSES

L. E. Franks and W. A. Gardner 10 May 1972 12 p refs Presented at 9th Ann. Allerton Conf. on Circuit and System Theory, Monticello, Ill., 6-8 Oct. 1971; sponsored by Ill. Univ.
(Grant AF-AFOSR-2111-71; AF Proj. 9769)
(AD-741929; AFOSR-72-1115TR) Avail: NTIS CSCL 09/4

The extent to which the time origin or phase of a cyclostationary process is known has a direct bearing on the design of the linear, periodically-varying filter used for detection or estimation. In the paper, the authors examine the continuous waveform estimation problem and compare performance with that of the best time-invariant filter. Illustrative examples involving various synchronous signal multiplexing schemes are presented. Author (GRA)

N72-30163# Mitre Corp., Bedford, Mass.

DISCRETE CLUTTER MEASUREMENTS PROGRAM: OPERATIONS IN WESTERN MASSACHUSETTS Technical Report, Jun. - Oct. 1970

William J. McEvoy Hanscom Field, Mass. ESD Mar. 1972 61 p
(Contract F19628-71-C-0002; AF Proj.)
(AD-742297; MTR-2074; ESD-TR-72-132) Avail: NTIS CSCL 17/9

The Mitre Corporation has been conducting a clutter measurements program aimed at providing data for use in the AWACS program. Preliminary results, obtained at Boston Hill, suggested the need for a mobile radar in order to study the grazing and azimuthal angle dependence of discrete clutter. A truck-mounted radar facility has been constructed and operated in the western area of Massachusetts. This report describes the facility and the results obtained. Author (GRA)

N72-30164# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.

EFFICIENT DIGITAL ENCODING METHODS FOR IMPROVED MILITARY COMMUNICATION SYSTEMS Annual Scientific Progress Report, 2 Apr. 1971 - 2 Apr. 1972

J. B. ONeal, Jr. 1 Apr. 1972 75 p
(Contract F44620-69-C-0033; AF Proj. 7921)
(AD-742310; AFOSR-72-1103TR; ASPR-4) Avail: NTIS CSCL 09/4

The project is divided into working groups; source encoding theory, speech encoding, and video encoding. The report consists of 12 reports: Source Encoding, A Comparison of Optimum and Logarithmic Quantization for Speech PCM and DPCM Systems, Video Encoding, Application of Shannon's Rate Distortion and Theory to Speech Encoding, Measurements of Information and Subjective Performance for Television on Real Differential PCM Systems, Optimum Constrained Order Digital Filters, Development of Subjective Testing Techniques, Scaling Quantizer Levels in the PCM Transmission of Television Signals, Subjective Evaluation of Speech Encoders, Difference Pulse Code Modulation Systems, and On the Value of the Fano Algorithm in Establishing the Graphemic Form of Machine-Derived Phonetic Strings. GRA

N72-30165# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.

OPTIMIZING COST, DESIGN, AND HUMAN VISUAL PERFORMANCE TRADEOFFS IN A DIGITAL TELEVISION ENCODING SYSTEM

James Alan Gardner Mar. 1972 43 p refs
(Contract F44620-69-C-0033; AF Proj. 7921; Proj. Themis)
(AD-742309; AFOSR-72-1102TR) Avail: NTIS CSCL 17/2

Tradeoff relationships among human visual performance, electronic design parameters, and system cost were determined for a digital television transmission system. These relationships were investigated by measuring subjects: minimum perceptible acuities for various length lines and spatial orientations. Variations in sampling frequency and binary code length were simulated for

a differential pulse code modulation encoding system by changing bandwidths and signal-to-noise ratios of pictures displayed on the monitor of a closed television system. Noise level, bandwidth, line length, spatial orientation, and the length by orientation interaction all significantly affected the perception of image detail. Visual performance was determined for points along four noise-bandwidth tradeoff curves representing different information capacities and system costs. Perception was profoundly affected by bandwidth and very little affected by system cost relative to the curves tested. Optimum system performance was achieved by maximizing the sampling frequency of the encoder. Author (GRA)

N72-30166# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.
ON THE VALUE OF THE FANO ALGORITHM IN ESTABLISHING THE GRAPHEMIC FORM OF MACHINE-DERIVED PHONETIC STRINGS
Arthur Steven Rabinowitz 31 Mar. 1972 168 p refs
(Contract F44620-69-C-0033; Proj. Themis)
(AD-741921; AFOSR-72-1106TR) Avail: NTIS CSCL 17/2

The problem of establishing the graphemic form of degenerate non-segmented phonetic strings is considered in the context of machine recognition of continuous speech. Syntax-controlled translation is formulated in terms of the heuristic development of a path through a finite directed graph determined by the conjunction of the sublanguage and possible segmentation errors of the acoustic analyzer. Author (GRA)

N72-30167# Michigan Univ., Ann Arbor. Radiation Lab.
THE NUMERICAL SOLUTION OF LOW FREQUENCY SCATTERING PROBLEMS
Thomas B. A. Senior and David J. Ahlgren Feb. 1972 111 p refs
(Contract F19628-68-C-0071; AF Proj. 5635)
(AD-741776; AFCRL-72-0162; Rept-013630-9-T) Avail: NTIS CSCL 20/14

The low frequency scattering of electromagnetic and acoustic waves by rotationally symmetric bodies is considered. By concentrating on certain quantities such as the normalised component of the induced electric and magnetic dipole moments, it is shown how the first one or two terms in the far zone scattered fields can be expressed in terms of quantities which are functions only of the geometry of the body. Each of these is the weighted integral of an elementary potential function which can be found by solving an integral equation. A computer program has been written to solve the appropriate equations by the moment method, and for calculating the dipole moments, the electrostatic capacity, and a further quantity related to the capacity. The program is described and related data are presented. Author (GRA)

N72-30168# Mitre Corp., Bedford, Mass.
TACTICAL AWACS MEASURES OF EFFECTIVENESS
C. R. Turner and J. F. Bard Apr. 1972 29 p
(Contract F19628-71-C-0002; AF Proj. 4110)
(AD-742233; MTR-2308; ESD-TR-72-142) Avail: NTIS CSCL 17/2

The purpose of this report is to establish a methodology and criteria for assessing the utility of AWACS when employed in a tactical environment. Prior analyses have often obscured the AWACS contributions to the performance of tactical air missions by directing their thrust at end-game results. The approach proposed herein is primarily directed at AWACS system level performance. Consequently, AWACS system level measures of effectiveness (MOE's) have been formulated. These MOE's have been designed to assess the contributions of AWACS when it is employed as an element of the Tactical Air Control System (TACS). In addition, MOE's have been derived to assess the effectiveness of nine generic tactical air missions which AWACS will be capable of supporting. Author (GRA)

N72-30169# North Carolina State Coll., Raleigh. Dept. of Electrical Engineering.
OPTIMUM QUANTIZATION IN SPEECH DPCM SYSTEMS
M. D. Paez and T. H. Glisson 4 Apr. 1972 25 p refs
(Contract F44620-69-C-0033; AF Proj. 7921)
(AD-741177; AFOSR-72-0865TR) Avail: NTIS CSCL 17/2

The optimum (minimum mean-squared-error) and optimum uniform quantizing characteristics for Laplacian- and gamma-distributed signals are given in tabular form. The performance of these quantizers in real speech PCM and DPCM systems is investigated and compared with the one obtained when the micro-law quantizing characteraretics are used. Author (GRA)

N72-30170# Naval Weapons Lab., Dahlgren, Va.
ANTENNA PATTERN AVERAGING
Joseph H. Halberstein Dec. 1971 19 p refs
(AD-740806; NWL-TR-2651) Avail: NTIS CSCL 09/5

The report provides a formula for the difference between the straight average of gain and the average in db for the case of Antenna patterns with normal pattern distribution functions. It is shown that the difference between the average or median db-gain and the straight average of the gain is typically 5-20db but may be even higher. The difference varies strongly with the standard deviation of the pattern distribution function. Author (GRA)

N72-30171# Army Electronics Command, Fort Monmouth, N.J.
PERFORMANCE OF TREES AS RADIO ANTENNAS IN TROPICAL JUNGLE FORESTS: PANAMA CANAL ZONE EXPERIMENTS
Kurt Ikrath, William Kennebeck, and Robert T. Hoverter Feb. 1972 67 p refs
(AD-742230; ECOM-3534) Avail: NTIS CSCL 09/5

Radio transmission and reception experiments in tropical jungle forest covered terrains are described and the performance of conventional whip antennas is compared with the performance of Hybrid Electromagnetic Antenna Couplers (HEMAC) in conjunction with jungle trees as antennas. Author (GRA)

N72-30172# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
AIRCRAFT TRACK INITIATION AND MAINTENANCE IN A SINGLE OPERATOR SIMULATED SURVEILLANCE SYSTEM TECHNICAL REPORT 2 Final Report
Robert G. Mills and Michael A. Bauer Oct. 1971 38 p
(AF Proj. 7184)
(AD-741902; AMRL-TR-71-76) Avail: NTIS CSCL 17/9

A semiautomatic radar surveillance system using a time-compression mode for display of real-time radar data was simulated. Subjects were required to detect targets entering the surveillance area (75 by 75 nautical miles), initiate automatic tracking of these targets, and reinitiate (maintain) lost tracks when automatic tracking failed. Four target introduction rates (2, 3, and 4/minute and a distributed rate with a mean of 2.5 targets/minute), three levels of clutter density (0.016, 0.032, and 0.064 pieces per square nautical mile), and two levels of target velocity (500 and 900 knots) were investigated. Author (GRA)

N72-30173# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FEASIBILITY STUDY OF WHOLE AIRCRAFT AS AN APERTURE ANTENNA M.S. Thesis
Samuel R. Weaver Mar. 1972 44 p refs
(AD-742439; GE/EE/72-27) Avail: NTIS CSCL 09/5

A set of assumed conditions that must be met to realize a radar antenna that conforms to a flexible irregular shape such as an aircraft surface are given. The theory and properties of adaptive arrays are reviewed along with the properties of aperiodic arrays. The results of some experimentation is cited to support the theory. An argument is then presented that by use of adaptive array techniques and widely spaced (several

wavelengths) array elements it is feasible to realize an airborne radar antenna that will conform to any desired shape. It is argued that it is feasible to determine target position by a combination of pattern computation and interferometer techniques having knowledge of the location of a relatively small number of the antenna elements. Author (GRA)

N72-30174# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF A 10.6 MICRON PRINTED CIRCUIT ANTENNA ARRAY M.S. Thesis
Henry W. Myers Mar. 1972 57 p refs
(AD-742440; GE/EE/72/S-1) Avail: NTIS CSCL 17/5

A printed-circuit antenna array for a wavelength of 10.6 microns is shown to be feasible, using analysis by the method of moments. An example of a thin dipole is analyzed before proceeding to the more complicated infrared dipole. Due to present printed-circuit technology, the infrared dipole must be a two-dimensional dipole, resulting in both axial and lateral components of current. Analysis shows that the lateral current, although fairly large, may be dropped without affecting the dipole radiation pattern. Mutual coupling between dipoles is used to determine the radiation pattern from the system; the result is a pencil beam normal to the plane of the antenna array. Author (GRA)

N72-30175# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A PHASED ARRAY ANTENNA WITH HEMISPHERIC SCAN FOR SATELLITE TRACKING M.S. Thesis
Thomas Burke Markham Mar. 1972 93 p refs
(AD-742433; GE/EE/72-15) Avail: NTIS CSCL 09/5

The possibility of replacing large highly directive parabolic antennas for satellite tracking with a phased array is investigated. It is shown that a non-planar array with a circular horizontal cross section and an elliptical vertical cross section has a far field radiation pattern suitable for satellite tracking. The problem is formulated for solution by a high speed digital computer and an analysis of the performance of the optimal array design is presented. Author (GRA)

N72-30176# General Dynamics Corp., San Diego, Calif. Electro Dynamic Div.
OCEAN DATA STATION LONG-RANGE TELEMETRY TESTS Technical Report, Jun. 1967 - Jan. 1968
F. W. Wundrow, K. Samples, R. F. Kosic, and K. A. Morgan Jan. 1972 51 p refs
(Contract N00014-70-C-0180; NR Proj. 083-147)
(AD-742459; R-71-044) Avail: NTIS CSCL 09/6

An experiment was conducted to test long-range telemetry communications between a buoy located off La Jolla, California and a Mobile Data Center being operated from several locations within the continental United States. Long-distance communications from the buoy were also monitored by U.S. Navy receiving stations in Alaska and Hawaii. Data obtained during these communications were evaluated to determine overall communication success. Radio communication predictions are compared with test results, and factors affecting communication success (such as time, space, and in-band-frequency diversity; transmitter frequency; and link quality) are evaluated. Factors having strong potential for improving buoy-to-shore communications are identified and evaluated. Author (GRA)

N72-30177# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY AND PRACTICE OF RADAR SYSTEM OPERATION
S. M. Latinskii, V. I. Sharapov, S. P. Ksenz, and S. S. Afanasev 1 Feb. 1972 472 p refs Transl. into ENGLISH of "Teoriya i Praktika Ekspluatatsii Radiolokatsionnykh Sistem" 1970 p 1-342
(AD-741156; FTD-HC-23-722-71) Avail: NTIS CSCL 17/9

The report discusses certain problems of the theory and practice of the operation of radar systems. The methods are directed toward achieving the maximum effective range of a system. Considerable attention is devoted to increasing the reliability of radio electronic equipment. It is one of the important technical problems. The book discusses a wide circle of problems connected with the design, manufacture, and operation of the equipment. Among these problems, increasing the equipment reliability in the design stage has a very important place. Equipment reliability may be increased if it is controlled in the design stage. Author (GRA)

N72-30178# Naval Postgraduate School, Monterey, Calif.
A DEVELOPMENTAL CW FM MULTI-TARGET RADAR M.S. Thesis
Ronald Patterson Lewis Dec. 1971 38 p refs
(AD-741141) Avail: NTIS CSCL 17/9

The feasibility of an X-band (8.0-12.5 GHz) continuous-wave multiple-target radar employing linear frequency modulation was investigated. From available laboratory equipment a working model was constructed and tested. Separate parabolic antennas were used for transmitting and receiving. The transmitter employs a reflex klystron followed by low and high-level traveling-wave tubes. The receiver uses a single narrow-band crystal filter with a swept local oscillator for range search. Target data acquired with the developmental unit is presented. Author (GRA)

N72-30179# California Univ., Berkeley. Operations Research Center.
A MULTI-COMMODITY CONCAVE COST MINIMIZATION PROBLEM FOR COMMUNICATION NETWORKS
Sen Subhabrata Feb. 1972 133 p refs
(Contract DA-31-124-ARO(D)-331; DA Proj. 2O0-14501-B-14C)
(AD-740119; ORC-72-5) Avail: NTIS CSCL 17/2

In this network synthesis problem a matrix giving flow requirements between each pair of points is specified, and the cost of flow in each arc is a concave function of the amount of flow. A flow pattern which fulfills the requirements at minimum cost is sought. The problem is formulated as a concave programming problem with linear constraints. All the practical difficulties of formulation and theoretical difficulties of identifying the globally minimal solution while avoiding locally minimal solutions are discussed. Author (GRA)

N72-30180# Bendix Corp., Southfield, Mich.
UNDERWATER VIEWING SYSTEM USING SOUND HOLOGRAPHY Final Technical Report, 1 May 1968 - 31 Jan. 1972
P. N. Keating, R. Koppelmann, and R. F. Steinberg Apr. 1972 88 p refs
(Contract N00014-68-C-0338)
(AD-740836; RLD-6140) Avail: NTIS CSCL 17/1

A feasibility study and prototype system development for an underwater viewing system based on acoustic holographic principles was initiated. The objective was to study various receiving array configurations and construct a modular prototype system to evaluate the capabilities of holographic concepts. In parallel, the development of a system for real-time optical reconstruction of sampled holograms was initiated. The report presents a summary of the program activities from its inception in 1968 to its completion in 1971. Accomplishments include completion of the design and construction of the underwater viewing system as well as that for the coherent light area modulator. Experimental verification of the system's operational capabilities was also completed. This includes the generation of holograms using the underwater viewing system and various target configurations, and the reconstruction of these holograms using the coherent light area modulator. Author (GRA)

N72-30181# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
RELATIVE ATTENUATION OF TM-TE WAVES PROPAGA-

TING IN THE EARTH-IONOSPHERE WAVEGUIDE
Paul A. Kossey and Edward A. Lewis 27 Jan. 1972 18 p refs
(AF Proj. 4603)
(AD-740578; AFCRL-72-0079; AFCRL-ERP-384) Avail: NTIS CSCL 20/14

Ionospheric and ground reflection coefficients for transverse magnetic (TM) and transverse electric (TE) waves are given, at a frequency of 17 kHz and over a wide range of incidence angles. Both normal and severely disturbed ionospheric conditions are considered, and the relative attenuations of the TM and TE waves upon reflection from a soil of high electrical conductivity, and from ice, are given. A method of determining modal resonance angles from computations of ionospheric and ground reflection coefficients is described, and estimates of the relative attenuation rates of the TM and TE waves propagating in the earth-ionosphere waveguide are given. Author (GRA)

N72-30182# Ohio State Univ., Columbus. Electroscience Lab.
IMPERFECT DIFFERENTIAL DETECTION OF A BIPHASE MODULATED SIGNAL: AN EXPERIMENTAL ANALYTICAL STUDY
Thomas W. Miller Griffiss AFB, N. Y. RADC Feb. 1972 105 p refs
(Contract F30602-69-C-0112)
(AD-740617; RADC-TR-72-16) Avail: NTIS CSCL 09/4

The results of an experimental investigation of the effects of bit synchronization error and carrier frequency uncertainty on the performance of receivers used to demodulate differential phase shift keyed (DPSK) signals are presented. Also, previous analytical results relating to the differential detector (DD) are summarized and an expression for the performance of the perfectly timed DD with frequency uncertainty is derived. The bit error probability and the probability of two consecutive errors are used as performance measures. The experimental and analytical results obtained apply to cases in which the carrier is biphase modulated with the differentially encoded bit stream, the (equivalent) noise at the receiver input is white and Gaussian distributed, the bit synchronization error is Gaussian distributed, and the error in the carrier frequency estimate is constant as a function of time. Author (GRA)

N72-30183# Continental Electronics Mfg. Co., Dallas, Tex.
DISPERSIBLE TRANSMITTING ANTENNA VLF/LF INVESTIGATION Final Technical Report, 9 Feb. - 9 Dec. 1971
Homer A. Ray, Jr. Griffiss AFB, N. Y. RADC Mar. 1972 74 p refs
(Contract F30602-71-C-0010)
(AD-740618; RADC-TR-72-28) Avail: NTIS CSCL 09/5

The program was for the purpose of studying the feasibility of an electrically short antenna which will provide a minimum radiated power of 100 watts in the frequency range from 27 to 60 kHz. The study produces data for the design of a dispersible antenna 100 feet high to be used in survivable low frequency communications systems. The system and methods proposed develop the maximum bandwidth-efficiency product and thereby offer good bandwidth as well as efficiency. Based upon previous study work, a special configuration was offered which has been named PARAN (Perimeter current antenna). It is based upon the principle, that if the vertical radiating portion of the current can be made to flow in a sheet on the perimeter of the available site area, then the maximum bandwidth-efficiency product for the available site will be developed. Author (GRA)

N72-30184# Syracuse Univ., N.Y.
USE OF THE CEPSTRUM FOR PROCESSING MULTIPATH SIGNALS Interim Report, 15 Sep. 1970 - 31 Dec. 1971
Harry Schwarzlander Griffiss AFB, N. Y. RADC Mar. 1972 73 p refs
(Contract F30602-70-C-0060; AF Proj. 0171)
(AD-740586; RADC-TR-72-44) Avail: NTIS CSCL 09/5

The report summarizes a study of the use of homomorphic filtering and cepstrum analysis for processing of communications signals which have been corrupted by multipath effects. The primary objective consisted of the development of computer programs by means of which simulated multipath signals, or actual received signals after conversion to digital form - can be processed so as to reduce or eliminate the distorting effect of multipath. This objective has been met for simple discrete multipath. Extensions to more complicated multipath structures are possible. Test results have been obtained using synthesized signal sequences that simulate actual communication signals of a particular type, namely, 16-channel PSK signals as they would be generated by an HF data modem. Author (GRA)

N72-30185# Martin Marietta Corp., Orlando, Fla.
TARGET ACQUISITION STUDIES Final Report
Frank D. Fowler and Daniel B. Jones Apr. 1972 27 p refs
(Contract N00014-67-C-0340; NR Proj. 196-071)
(AD-740787; OR-11901) Avail: NTIS CSCL 17/8

The report presents the final results of studies to obtain baseline data about human target acquisition performance. Factors considered crucial to the acquisition problem were varied parametrically while others were held constant. The results are reported in five major phases corresponding to organization of the investigation into particular areas of concentration.
Author (GRA)

N72-30186# Pennsylvania Research Associates, Inc., Philadelphia.
DEVELOPMENT OF A HYBRID RADAR LANDMASS SIMULATOR Technical Report, Jun. 1970 - Jun. 1971
Paul A. T. Wolfgang Jun. 1971 146 p refs
(Contract N61339-70-C-0262)
(AD-740788; PRA-U71-1298; NAVTRADEVCEN-70-C-0262-2; TR-7) Avail: NTIS CSCL 17/9

An integrated set of computer software is described for the generation of airborne radar displays, simulating the earth's topographic features and man-made objects to the extent they are apparent on the indicator of a modern scanning radar, as a function of the aspect from which the earth is viewed and the salient characteristics of the viewing radar system. The programs are based on previous PRA work in the simulation of air-to-ground radar displays and provide a versatile laboratory tool for the evaluation of radar simulation techniques with a variety of user options for adjusting scale factors, inserting/deleting special effects, changing the precision of the calculations, incorporating nonlinearities, and varying characteristics of the simulated radar and its antenna. Author (GRA)

N72-30187# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
SCATTERING OF HF RADIO WAVES BY ELLIPTICAL ELECTRON DENSITY DISTRIBUTIONS Physical Sciences Research Paper
Victor L. Corbin and Milton M. Klein 17 Jan. 1972 43 p refs
(AF Proj. 7635)
(AD-740576; AFCRL-72-0047; AFCRL-PSRP-474) Avail: NTIS CSCL 20/14

The differential and total cross sections for ellipsoids and elliptic cylinders having Gaussian electron density distributions have been obtained by a ray tracing procedure. Calculations for the case of an external magnetic field were restricted to the ellipsoidal distributions. The results show that the scattering is extremely sensitive to the orientation of the body. A peak in cross section occurs at the scattering angle corresponding to the ray normal to the critical surface, and increases as the surface becomes flatter. Author (GRA)

N72-30188# Naval Postgraduate School, Monterey, Calif.
ON REALIZATION OF TERMINAL CAPACITY MATRICES M.S. Thesis
Tahsin Karan Dec. 1971 54 p refs
(AD-741073) Avail: NTIS CSCL 17/2

The paper presents three algorithms for minimum cost

synthesis of an oriented communication net. The realization technique is developed using the min-cut max-flow theorem. The algorithms are able to handle higher order terminal capacities compared to previous methods. Necessary and sufficient conditions are given for the application of the algorithms, which are suitable for computer implementation. Author (GRA)

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

N72-30189*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATIONS OF SYMBOLIC COMPUTING METHODS TO THE DYNAMIC ANALYSIS OF LARGE SYSTEMS
Carl F. Lorenzo and John P. Riehl 1971 34 p refs Presented at 5th Congr. of the Intern. Federation of Autom. Control, Paris, 12-17 Jun. 1972
(NASA-TM-X-67908; E-6519) Avail: NTIS HC $3.75 CSCL 09B

Since the symbolic computing language is very well suited to the operations with algebraic equations, techniques use the transfer function concept as a tool for the analysis of large linear dynamic systems. Techniques were coded in the experimental symbolic computer language FORMAC. The first of these approaches, REDUCE 1, establishes the techniques and a computer program to symbolically reduce arbitrary block diagrams associated with large systems for desired transfer functions. Symbolic closed form solutions are determined in several forms including an expanded form in terms of the driving frequencies and system constants. Programs are also written to numerically evaluate the symbolic solutions. A second computer program, REDUCE 2, is also based on the use of symbolic computing methods and was written to accommodate large engineering systems. Author

N72-30190*# Teledyne Brown Engineering, Huntsville, Ala.
DEVELOPMENT OF AMTRAN ON THE DATACRAFT DC6024 Interim Report
May 1972 44 p
(Contract NAS8-26756)
(NASA-CR-123796; MSFC-SE-1528) Avail: NTIS HC $4.25 CSCL 09B

The AMTRAN system was implemented on the Datacraft DC6024 computer. Activities were directed toward providing greater user convenience and faster operation, development of a multiuser time sharing capability, and system support for user applications. The major portion of time was devoted to completing a two-user time sharing operating system and initiating work on an n-user system, with plans to provide service to up to n=8 users at this time. Flowcharts for the multiuser AMTRAN system are presented. The Datacraft DC6024 AMTRAN time sharing system comprises both software internal to AMTRAN and in the computer operating system. Only the AMTRAN portion is presented. Author

N72-30191*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
QUANTIZATION NOISE IN DIGITAL SPEECH M.S. Thesis - Houston Univ.
Oron L. Schmidt Aug. 1972 67 p refs
(NASA-TM-X-58097; MSC-07225) Avail: NTIS HC $5.50 CSCL 09B

The amount of quantization noise generated in a digital-to-analog converter is dependent on the number of bits or quantization levels used to digitize the analog signal in the analog-to-digital converter. The minimum number of quantization levels and the minimum sample rate were derived for a digital voice channel. A sample rate of 6000 samples per second and lowpass filters with a 3 db cutoff of 2400 Hz are required for 100 percent sentence intelligibility. Consonant sounds are the first speech components to be degraded by quantization noise. A compression amplifier can be used to increase the weighting of the consonant sound amplitudes in the analog-to-digital converter. An expansion network must be installed at the output of the digital-to-analog converter to restore the original weighting of the consonant sounds. This technique results in 100 percent sentence intelligibility for a sample rate of 5000 samples per second, eight quantization levels, and lowpass filters with a 3 db cutoff of 2000 Hz. Author

N72-30192# National Bureau of Standards, Washington, D.C. Information Processing Technology Div.
THE EFFECTS OF MAGNETIC FIELDS ON MAGNETIC STORAGE MEDIA USED IN COMPUTERS
Sidney B. Geller Jul. 1972 36 p refs
(NBS-TN-735) Avail: SOD $0.40 as C 13.46:735

The effects on recorded media of magnetic fields that are produced by sources such as permanent magnets are investigated. Guidelines for protecting magnetic tape, disk and drum files by installation managers are suggested. Author

N72-30193# Electronic Systems Div., L. G. Hanscom Field, Mass.
COMPUTER PROGRAM TESTING
William L. Trainor and R. W. Harris Nov. 1971 31 p refs
(AD-742245; ESD-TR-71-387) Avail: NTIS CSCL 09/2

The technical report addresses the general area of computer program testing. The test program for computer programs is, in many cases, different from that for equipment due to the uniqueness of the computer program configuration item. Thus, testing concepts for computer programs are not always widely understood. This technical report attempts to clarify computer program testing requirements and procedures by considering such topics as test requirements documents and test plans/procedures/reports. The concepts of informal versus formal testing are introduced, which lead to the subjects of preliminary and formal qualification testing. Subprogram, functional, and computer program configuration item levels of testing are also explained, and these ideas are in turn related to informal versus formal testing. Author (GRA)

N72-30194# Sperry Rand Corp., St. Paul, Minn. UNIVAC Defense Systems Div.
UNIVERSAL FUNCTION THEORY AND GALOIS LOGIC STUDIES Final Report, 1 Jun. 1971 - 31 Jun. 1972
James T. Ellison Mar. 1972 54 p refs
(Contract F19628-71-C-0208; AF Proj. 5632; AF Proj. 5632)
(AD-740849; AFCRL-72-0109) Avail: NTIS CSCL 09/2

The report advances work in two areas relevant to logic design in an MSI/LSI technology. First, the theory of universal functions is advanced to the full generality of finite mathematical structures. Second, the theory of Galois logic design is enhanced in various ways. Various Galois lattice-like operations are defined and compared. Next, methods of converting Galois multiplication gates to binary additon gates and to Galois linear gates are described. Finally, techniques are offered using the Galois linear module to reduce hardware at the cost of switching speed. Author (GRA)

N72-30195# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN AND FABRICATION OF A CONTROL CONSOLE FOR THE MINUTEMAN 1 D17B COMPUTER M.S. Thesis
Robert C. Brady and Charlie D. Huskey Mar. 1972 126 p refs
(AD-742437; GE/EE/72-3) Avail: NTIS CSCL 09/2

The thesis describes the design and fabrication of a control console for the Minuteman 1 D17B computer. The console was built so that the D17B could be used in a laboratory for reutilization study and digital experimentation. Circuit design

procedures, theory of operation, and detailed schematic diagrams are provided. Also, operating instructions, maintenance check-out procedures, wire lists, signal specifications, and a parts list are included. The information necessary to operate and maintain the D17B Computer Control Console is provided in this thesis. It can also serve as engineering data documentation to others interested in a similar project. Author (GRA)

N72-30196# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DEVELOPMENT OF INPUT/OUTPUT INTERFACE FOR THE D17B COMPUTER M.S. Thesis
Robert M. Schaff 24 Mar. 1972 135 p refs
(AD-742438; GE/EE/72-21) Avail: NTIS CSCL 09/2

A synchronous serial-binary D-17B Computer, removed from a surplus Minuteman I missile, was added to the facilities of the Digital Engineering Laboratory at the Air Force Institute of Technology, WPAFB, Ohio. This report briefly describes the computer and presents information on the design and construction of interface circuits and controls for operation of a teletypewriter, a photoelectric paper tape reader and a high speed paper tape punch with the computer. Integrated circuit logic elements and wire wrapping techniques are used extensively. The resulting system enables digital engineering students to program the computer and to use it for laboratory experiments and research projects. Author (GRA)

N72-30197# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
REGULAR EXPRESSIONS AND SUBSET SPECIFIED SEQUENTIAL MACHINES M.S. Thesis
Edward Stephen Hinton Mar. 1972 65 p refs
(AD-742435; GE/EE/72-14) Avail: NTIS CSCL 09/2

The relationship between regular expressions and subset-specified sequential machines is derived through the use of a specialized machine, the subset-specified tape acceptor. This machine is described by two regular expressions, one of which represents the set of sequences which is an upper bound to the szt accepted by the machine, and the other, the lower bound. An inverse procedure is presented which starts with two regular expressions, one which represents a set of sequences that must be accepted, and another which represents a set that may or may not be. From these, a subset-specified sequential machine is derived which can be reduced by the method of Purnhagen to a completely specified machine which accepts the required set of sequences. Author (GRA)

N72-30198# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A DIGITAL LOGIC DESIGN CONSOLE M.S. Thesis
Clyde Cecil Turquette Mar. 1972 104 p refs
(AD-742427; GE/EE/72-26) Avail: NTIS CSCL 09/2

A need exists in the Electrical Engineering Department at AFIT for a digital laboratory in which practical applications of courses taught in switching theory and digital systems can be made. Part of this need is filled by the digital logic design console described in this thesis. The console consists of a collection of TTL integrated circuit logic elements which are connected through the use of patch cords. There is sufficient logic to construct complex combinational circuits, and even a small computer complete with a semiconductor memory. The result is a reliable and flexible system that can perform many functions in the laboratory. Author (GRA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N72-30199*# Texas A&M Univ., College Station. Inst. for Solid-State Electronics.
ANALYSIS OF SIGNAL TO NOISE ENHANCEMENT USING A HIGHLY SELECTIVE MODULATION TRACKING FILTER Final Report
C. R. Haden and C. W. Alworth 1 Jun. 1972 17 p
(Contract NAS9-9285; Proj. 1177-32)
(NASA-CR-115764) Avail: NTIS HC $3.00 CSCL 09C

Experiments are reported which utilize photodielectric effects in semiconductor loaded superconducting resonant circuits for suppressing noise in RF communication systems. The superconducting tunable cavity acts as a narrow band tracking filter for detecting conventional RF signals. Analytical techniques were developed which lead to prediction of signal-to-noise improvements. Progress is reported in optimization of the experimental variables. These include improved Q, new semiconductors, improved optics, and simplification of the electronics. Information bearing signals were passed through the system, and noise was introduced into the computer model. Author

N72-30200*# National Aeronautics and Space Administration, Washington, D.C.
SHOCK AND VIBRATION TECHNOLOGY WITH APPLICATIONS TO ELECTRICAL SYSTEMS Technology Utilization
Ronald L. Eshleman (ITT Res. Inst.) 1972 170 p refs
(NASA-SP-5100; Ic-70-174580) Avail: NTIS; SOD $1.00 CSCL 09C

A survey is presented of shock and vibration technology for electrical systems developed by the aerospace programs. The shock environment is surveyed along with new techniques for modeling, computer simulation, damping, and response analysis. Design techniques based on the use of analog computers, shock spectra, optimization, and nonlinear isolation are discussed. Shock mounting of rotors for performance and survival, and vibration isolation techniques are reviewed. F.O.S.

N72-30201# Joint Publications Research Service, Arlington, Va.
PRINCIPLES AND PROBLEMS OF MICROELECTRONICS
S. D. Svechnikov 22 Aug. 1972 22 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), v. 27, no. 5, 1972
(JPRS-56833) Avail: NTIS HC $3.00

Basic trends of modern microelectronics, including developments in integral, film, functional, and optical electronics are defined and examined. Author

N72-30202*# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
AN OPTIMAL PHASE DEMODULATOR Interim Report
Richard S. Bucy and Albert J. Mallinckrodt (Commun. Res. Labs., Santa Ana, Calif.) Mar. 1972 32 p refs
(Contract NAS5-10789; Grant AF-AFOSR-2141-71; AF Proj. 9749)
(NASA-CR-128024; AFOSR-72-0539TR; AD-738321) Avail: NTIS HC $3.75 CSCL 09C

The results of an investigation on the optimal performance of the phase demodulator using Bucy's nonlinear filtering theory is presented. A cyclically optimal nonlinear phase estimation technique was developed for modular phase tracking systems. A first-order Markov or Brownian motion phase process is considered, because of faster computation in digital simulations and for the extensive research results available in Weiner

optimum phase-lock loop for comparison purposes. The actual performance of the nonlinear filter was investigated using Monte Carlo techniques. The classical phase-lock loop was also simulated as a reference against which the optimal nonlinear filter was compared. Author

N72-30203# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
PONDEROMOTIVE STABILITY OF HIGH-FREQUENCY RESONATORS AND RESONATOR REGULATING SYSTEMS Ph.D. Thesis - Karlsruhe Univ.
Dietrich Schulze Dec. 1971 174 p refs In GERMAN; ENGLISH summary
(KFK-1493) Avail: AEC Depository Libraries

Linear and nonlinear stability conditions for an RF-cavity exposed to large ponderomotive (electromagnetic) forces are derived and discussed. Stabilization techniques using amplitude and phase control loops are investigated. It is shown, that ponderomotive stability can be insured by proper choice of control parameters. Under certain conditions, ponderomotive forces can damp mechanical oscillations induced by external sources. The calculated stability thresholds, the effectiveness of stabilizing and the damping property of the electromagnetic field could be confirmed experimentally. These experiments were carried out with a superconducting helically loaded resonator within construction of a superconducting proton linear accelerator at Karlsruhe. Author (NSA)

N72-30204# Harry Diamond Labs., Washington, D.C.
LINEAR FREQUENCY MODULATION OF OSCILLATORS
Louis M. Tozzi Mar. 1972 30 p
(DA Proj. 1W2-62301-A-207)
(AD-742220; HDL-TR-1586) Avail: NTIS CSCL 09/5

A technique is described for using varactors to obtain wideband frequency modulation of an oscillator. The modulation characteristics are linear with modulating voltage to within a fraction of a percent over bandwidths of up to 10 percent. Attainable linearity is a function of the bandwidth sought. The technique employed depends on the proper proportioning of a two-pole RF network in which the varactors are a component. It is shown that the higher frequency impedance pole moves linearly with varactor tuning voltage over the desired bandwidths. The technique is theoretically adaptable to any varactor power law. Graphs have been computed for varactors having capacitance of the form C – a/ the square root of V. Author (GRA)

N72-30205# Watkins-Johnson Co., Palo Alto, Calif.
ELECTRON BOMBARDED SEMICONDUCTOR SHORT PULSE GENERATOR Triannual Report No. 4, 1 Aug. - 30 Nov. 1971
Aris Silzars May 1972 34 p
(Contract DAAB07-70-C-0268; W-J Proj. 22-4083)
(AD-741856; W-J-22-4083-4; ECOM-0268-4) Avail: NTIS CSCL 09/5

The fabrication, processing, and electrical testing of three high-current pulse amplifiers were completed. The input circuit and output load circuit were optimized. Sixty amperes of output current with 2 nanoseconds risetime were obtained from a tube containing two 0.35 sq cm area diodes. Fabrication of large area semiconductor targets continued. Diodes were successfully fabricated from 37 micrometers, 22 ohm-cm epitaxial silicon. A tube was assembled and processed through bakeout and cathode activation with the new expitaxial silicon targets. No change in diode reverse breakdown voltage was observed during processing or during pulsed operation of the high current amplifiers. Author (GRA)

N72-30206# Hazeltine Corp., Braintree, Mass.
SWITCHABLE ACOUSTIC MATCHED FILTER Final Report, Mar. 1971 - Jan. 1972
William C. Fifer, Richard LaRosa, and John F. Crush Griffiss AFB, N. Y. RADC Apr. 1972 56 p refs
(Contract F30602-71-C-0199)
(AD-741767; RADC-TR-72-72; Rept-7974) Avail: NTIS CSCL 09/5

The design, fabrication, and evaluation of an experimental, 127-tap electronically programmable, acoustic surface wave sequence generator and matched filter for PSK bi-phase spread spectrum signals is described. This design demonstrated the economic feasibility of electronically programming, on a bit-by-bit basis, the code sequences for a bi-phase PSK sequence generator and matched filter. Author (GRA)

N72-30207# Rome Air Development Center, Griffiss AFB, N.Y.
RELIABILITY PROBLEMS WITH SiO2 PASSIVATION AND GLASSIVATION
Clyde H. Lane Mar. 1972 39 p refs
(AF Proj. 5519)
(AD-741765; RADC-TR-72-55) Avail: NTIS CSCL 09/5

The effect of differential expansion or contraction on the integrity of silicon integrated circuits is treated in part in this report. Specifically, relaxation of interface stress between Si and SiO2, cracks in Si or SiO2 due to upquenching, and problems with glassivation are addressed. The problems are shown to be real, and some suggestions for handling the difficulties are given. Author (GRA)

N72-30208# Research Triangle Inst., Durham, N.C.
OPERATION AND MAINTENANCE MANUAL, MICROELECTRONIC WAFER AND INTEGRATED CIRCUIT TEST SET, TTU-311/E (XV-1) Technical Report, 28 May 1970 - 31 Aug. 1971
Kirtland AFB, N. Mex. AFWL Jan. 1972 46 p
(Contracts F29601-69-C-0147; F29601-70-C-0071; AF Proj. 133B; AF Proj. 5710)
(AD-742237; AFWL-TR-71-122) Avail: NTIS CSCL 09/5

Procedures are given for operation and maintenance of test set TTU-311/E. The test set is used as an operator aid in the visual inspection of integrated ciruits on the production line. A functional description is first given, followed by operational procedures. System maintenance procedures are then described. Author (GRA)

N72-30209# Research Triangle Inst., Durham, N.C.
FABRICATION OF THE VIDEO PROTOTYPE MACHINE Technical Report, 28 May 1970 - 31 Aug. 1971
R. L. Beadles and P. P. Rasberry Jan. 1972 72 p refs
(Contracts F29601-69-C-0147; F29601-70-C-0071; AF Proj. 133B; AF Proj. 5710)
(AD-742238; AFWL-TR-71-106) Avail: NTIS CSCL 09/5

The report describes the design, fabrication, and preliminary evaluation of a test set to be used for visual inspection of integrated circuits (IC's) on the production line. Laser illumination and spatial frequency filtering are incorporated in the test set. The test set operator is thereby presented with an IC image in which defects on the IC surface are enhanced (made clearly visible) and the detailed circuit pattern is suppressed. The IC image is magnified by 50 to 200 times and displayed on a high resolution closed circuit television monitor. Both spatially filtered and unfiltered images are available. Author (GRA)

N72-30210# Office of Naval Research, Arlington, Va.
ELECTRONICS TECHNOLOGY IN JAPAN
Jay Froman 18 Apr. 1972 28 p
(AD-742074; ONR-31) Avail: NTIS CSCL 09/3

The report covers a brief liaison visit to Japanese industrial laboratories to obtain a broad coverage of recent progress in fields such as microwaves, electron physics, computer components, semiconductors, and electron devices in general. Author (GRA)

N72-30211# Cambridge Memories, Inc., Newton, Mass. Magnetic Thin Film Development Dept.
RESEARCH IN FERROMAGNETICS: DOMAIN TIP

PROPAGATION DEVICES Final Report, 28 Feb. - 31 Dec. 1971
Harvey I. Jauvtis and Robert J. Spain 31 Jan. 1972 98 p refs
(Contract F19628-69-C-0270; AF Proj. 5632)
(AD-741780; AFCRL-72-0160; Rept-070-F) Avail: NTIS CSCL 09/2

The DOT aluminum underlayer was investigated. Experimental results for the coercivity of the film over aluminum as a function of aluminum and magnetic thicknesses and aluminum deposition substrate temperature are presented. Additional studies on the subject of DOT inductive readout are described. A new technique for doubling the signal amplitude is illustrated and the channel structure optimized. DOT element evaluation is discussed. The effect of channel width, magnetic film thickness and aluminum deposition substrate temperature on channel propagation thresholds is considered. Two DOT memory systems are described. One a shift register, the other a BORAM (Block Oriented Random Access Memory) demonstrate many of the features of the DOT technique. Nuclear radiation experiments are discussed. A correction of a previously reported result is presented. Author (GRA)

N72-30212# Massachusetts Univ., Amherst. Dept. of Electrical Engineering.
IMPLEMENTATION OF N-PATH FILTERS USING TWO-LEVEL MODULATION M.S. Thesis
Lynn D. Dann 10 May 1972 96 p refs
(Grant AF-AFOSR-2111-71; AF Proj. 9769)
(AD-741919; AFOSR-72-1113TR; TR-1) Avail: NTIS CSCL 09/5

Recently, renewed interest has been given to the use of N-path filters as an alternative method of realizing analog filters. The N-path filter is a configuration composed of N-parallel paths containing identical path filters flanked by input and output modulators. The design of an N-path filter requires that its periodic modulating functions provide a desired set of Fourier coefficients while the rest of the Fourier coefficients may be arbitrary. To illustrate this numerical method, three applications of the N-path filter that are of practical interest are considered: A single passband filter; A least mean-squared error filter; A filter matched to a periodic input signal. Author (GRA)

N72-30213# IBM Watson Research Center, Yorktown Heights, N.Y.
INVESTIGATION OF HIGHLY-DOPED SCHOTTKY-BARRIER FIELD-EFFECT TRANSISTORS Final Report, 20 Aug. 1969 - 31 Dec. 1971
Theodor O. Mohr 15 Jan. 1972 40 p refs
(Contract F19628-70-C-0094; AF Proj. 5710)
(AD-740959; AFCRL-72-0102) Avail: NTIS CSCL 09/1

The electrical properties of Schottky-barrier field-effect transistors realized in silicon and GaAs technology have been investigated in the medium and high doping range (10 to the 17th power/cc to 10 to the 18th power/cc) for the conducting channel. This report summarizes the present status of work and describes the significant steps taken in the optimization of microwave properties. In the first chapter design parameters are discussed. The second chapter reports on measured microwave properties as obtained on our best 1 micrometer silicon and GaAs Schottky-barrier field-effect transistors. The third chapter deals with future improvements expected to be attained. The last chapter summarizes the most important steps taken in GaAs technology to achieve optimal device properties and describes the latest results obtained on transistors with high doping concentrations in the conducting channel. Author (GRA)

N72-30214# Interand Corp., Rockville, Md.
WHISKER REINFORCEMENT OF PIEZOELECTRIC TRANSDUCER CERAMIC FOR NAVAL APPLICATIONS Final Report
Kenneth E. Feith and Gerald S. Kerr 7 Mar. 1972 135 p refs
(Contract N00014-70-C-0182)
(AD-742118) Avail: NTIS CSCL 09/1

The introduction of sapphire whisker reinforcement to Type I, II, and III piezoelectric ceramic compositions has resulted in dynamic strength increases up to 500% of nonreinforced counterparts. Attendant benefits include improved aging characteristics, reduced dielectric losses, increased dielectric strength, and improved large signal piezoelectric properties and performance. Gamma radiation of nonreinforced materials produced up to 30% increases in dynamic strength while degrading strength of reinforced counterparts. Author (GRA)

N72-30215# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
NULL STEERING AND MAXIMUM GAIN IN ELECTRONICALLY SCANNED DIPOLE ARRAYS
C. J. Drane, Jr. and J. F. McIlvenna 1 Feb. 1972 39 p refs
(AF Proj. 5635)
(AD-740579; AFCRL-72-0083; AFCRL-PSRP-478) Avail: NTIS CSCL 09/5

A technique that simultaneously maximizes the gain of an antenna array and places a number of independent nulls in the radiation pattern has already been presented. The elements used were idealized point sources. In the present paper, the previous analysis is extended to cover arrays of thin wire elements in which interelement mutual coupling and scanning effects are included. Sample calculations and computed radiation patterns demonstrate that an appreciable amount of pattern and sidelobe control can be obtained with only a small sacrifice in gain. Author (GRA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N72-30216*# Bell Aerospace Co., Buffalo, N.Y.
SHUTTLE FREE-FLYING TELEOPERATOR SYSTEM EXPERIMENT DEFINITION. VOLUME 1: EXECUTIVE SUMMARY Final Report
Jun. 1972 46 p
(Contract NAS8-27895)
(NASA-CR-123793; DPD-261-DR-MA04-Vol-1; D7425-953004-Vol-1) Avail: NTIS HC $4.50 CSCL 09C

The applicability and utility of a free-flying teleoperator system were evaluated to support future earth orbital missions, specific emphasis on the early missions of the space shuttle. In-flight experiments and tests were specified, which will provide sufficient experience and data applicable to the development of future operational systems. The definition of a useful early experimental system is presented, which will be checked out and used with early shuttle missions. Author

N72-30217*# Bell Aerospace Co., Buffalo, N.Y.
SHUTTLE FREE-FLYING TELEOPERATOR SYSTEM EXPERIMENT DEFINITION. VOLUME 3: PROGRAM DEVELOPMENT REQUIREMENTS Final Report
Jun. 1972 91 p
(Contract NAS8-27895)
(NASA-CR-123792; DPD-261-DR-MA04-Vol-3; D7425-953004-Vol-3) Avail: NTIS HC $6.75 CSCL 09C

The planning data are presented for subsequent phases of free-flying teleoperator program (FFTO) and includes costs, schedules and supporting research and technology activities required to implement the free-flying teleoperator system and associated flight equipment. The purpose of the data presented is to provide NASA with the information needed to continue development of the FFTO and integrate it into the space shuttle program. The planning data describes three major program phases consisting of activities and events scheduled to effect integrated design, development, fabrication and operation of an

FFTO system. Phase A, Concept Generation, represents a study effort directed toward generating and evaluating a number of feasible FFTO experiment system concepts. Phase B, Definition, will include preliminary design and supporting analysis of the FFTO, the shuttle based equipment and ground support equipment. Phase C/D, Design, Development and Operations will include detail design of the operational FFTO, its integration into the space shuttle, hardware fabrication and testing, delivery of flight hardware and support of flight operations. Emphasis is placed on the planning for Phases A and B since these studies will be implemented early in the development cycle. Phase C/D planning is more general and subject to refinement during the definition phase. Author

N72-30218*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON A STOCHASTIC CONTROL METHOD FOR WEAKLY COUPLED LINEAR SYSTEMS M.S. Thesis
Raymond Hon-Sing Kwong May 1972 103 p refs
(Grants NGL-22-009-124; AF-AFOSR-1941-70; AF-AFOSR-2273-72)
(NASA-CR-127910; ESL-R-480) Avail: NTIS HC $7.25 CSCL 09C

The stochastic control of two weakly coupled linear systems with different controllers is considered. Each controller only makes measurements about his own system; no information about the other system is assumed to be available. Based on the noisy measurements, the controllers are to generate independently suitable control policies which minimize a quadratic cost functional. To account for the effects of weak coupling directly, an approximate model, which involves replacing the influence of one system on the other by a white noise process is proposed. Simple suboptimal control problem for calculating the covariances of these noises is solved using the matrix minimum principle. The overall system performance based on this scheme is analyzed as a function of the degree of intersystem coupling. Author

N72-30219*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
DESIGN OF MINIMAX OUTPUT FEEDBACK CONTROLLER FOR SYSTEM WITH PARAMETER UNCERTAINTY
Sibnath Basuthakur and Chaples H. Knapp Jun. 1972 27 p refs
(Grant NGL-07-002-002)
(NASA-CR-127814; TR-72-4) Avail: NTIS HC $3.50 CSCL 09C

The problem of controlling a time-invariant system with parameter uncertainty is considered with incomplete state feedback. The controller is designed by minimaximizing a quadratic performance criterion and a sensitivity (or loss) criterion, involving the state of the system, the control, and the uncertainty vector. The resulting optimal controller is linear and optimal feedback gain matrix must satisfy a set of nonlinear algebraic equations. some algorithms for algebraic minimax problems are presented. Author

N72-30220*# Scientific Translation Service, Santa Barbara, Calif.
SOVIET WORK ON AUTOMATIC CONTROL IN OUTER SPACE (1957 - 1967)
B. N. Petrov and B. V. Raushenbakh Washington NASA Jul. 1972 17 p refs Transl. into ENGLISH from "Trans. of the 2d Intern. Symp. of IFAC for Autom. Control in the Peaceful Use of Outer Space, Vienna, Sep. 1967" Moscow, Nauka Press, 1971 p 11-18
(Contract NASw-2035)
(NASA-TT-F-14379) Avail: NTIS HC $3.00 CSCL 22B

The history of automatic control in Russia is reviewed. This includes: temperature control, launch vehicles, communication satellites, weather satellites, planetary satellites, lunar satellites, manned flights. Author

N72-30221# Joint Publications Research Service, Arlington, Va.
CYBERNETICS AND CONTROL THEORY
7 Aug. 1972 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 203, no. 5, v. 204, no. 2, 1972 (JPRS-56696) Avail: NTIS HC $3.00

Presented is a proof of the theorem: the class of recursive P-functions coincides with the class of P-functions which are computable on probability Turing machines. Also considered is the synthesis of optimal linear stabilization systems. For individual titles, see N72-30222 through N72-30223.

N72-30222 Joint Publications Research Service, Arlington, Va.
PROBABILITY TURING MACHINES AND RECURSIVE FUNCTIONS
A. N. Maslov *In its* Cybernetics and Control Theory 7 Aug. 1972 p 1-5 refs (For availability see N72-30221 21-10)

A class of functions is described which are computable on Turing machines while utilizing a random number generator. A Turing machine which utilizes a random number generator producing 0 with a probability p and 1 with a probability 1 - p, where p is a constructive number computes the P-function f(x) for which (f(x)) sub i is the probability of obtaining the number i on the output tape for a finite ordered input sequence of x epsilon N sup k. It is stipulated that the class of functions computable on a probability Turing machine is closed with respect to superposition, primitive recursion, and minimization; that every P-function which is computable on a probability Turing machine is recursive; and that the class of recursive P-functions coincides with the class of P-functions which are computable on probability Turing machines. G.G.

N72-30223 Joint Publications Research Service, Arlington, Va.
SYNTHESIS OF OPTIMAL LINEAR STABILIZATION SYSTEMS
V. B. Larin, K. I. Naumenko, and V. N. Suntsev *In its* Cybernetics and Control Theory 7 Aug. 1972 p 6-10 refs (For availability see N72-30221 21-10)

A solution algorithm is proposed for problems of synthesizing optimal control devices in a feedback loop with random external stimuli by formulating an equation for the controlling device such that the closed loop system is stable. Special selection of a type of variable matrix reduces the problem to that of solving a corresponding Wiener-Hopf equation in a particular domain. G.G.

N72-30224*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DIFFERENTIAL GEOMETRIC METHODS IN CONTROL
H. T. Sussmann 31 Jul. 1972 132 p refs
(Grant NGR-22-007-172; Contract N00014-67-A-0298-0006)
(NASA-CR-120946) Avail: NTIS HC $8.75 CSCL 09C

A series of investigations on problems of the type which arise in the control of switched electrical networks is presented. The main results concern the controllability and observability of these systems. For individual titles, see N72-30225 through N72-30230.

N72-30225* Harvard Univ., Cambridge, Mass.
SYSTEM THEORY ON GROUP MANIFOLDS AND COSET SPACES
R. W. Brockett *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 1-38 refs (For availability see N72-30224 21-10)
CSCL 09C

Controllability, observability, and realization theory are studied for a particular class of systems for which the state space is a differentiable manifold which is simultaneously a group or, more generally, a coset space. It is possible to give rather explicit expressions for the reachable set and the set of indistinguishable states in the case of autonomous systems. A type of state space isomorphism theorem is established. These results parallel, and in part specialize to, results available for the familiar case

described by the differential of x(t) = Ax(t) + Bu(t); y(t) = Cx(t). The objective is to reduce all questions about the system to questions about Lie algebras generated from the coefficient matrices entering in the description of the system and in that way arrive at conditions which are easily visualized and tested. Author

N72-30226* Harvard Univ., Cambridge, Mass.
THE CONTROL PROBLEM DIFFERENTIAL OF x EQUALS (A(1 MINUS u) PLUS Bu)x: A COMMENT ON AN ARTICLE BY J. KUCERA
Hector J. Sussman *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 39-44 ref (For availability see N72-30224 21-10)
CSCL 09C

A lemma, which is a fundamental step in the proof of two theorems in the Kucera article, is shown to be false. Author

N72-30227* Harvard Univ., Cambridge, Mass.
THE BANG-BANG PROBLEM FOR CERTAIN CONTROL SYSTEMS IN GL(n,R)
H. T. Sussmann *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 45-59 refs (For availability see N72-30224 21-10)
CSCL 09C

The following linear control problem is discussed: X(t) = (A sub 0 (t) + summation from i = 1 to m of u sub i (t) A sub i (t)) X(t), where A sub 0,..., A sub m are n x n matrix-valued functions of time, and where X(t) is an element of GL(n,R). It is shown that the set attainable from any element M of GL(n,R) at time t by bang-bang controls is closed, provided that following very strong assumption is satisfied: for all i,j and for all t',t' such that 0 < or = t' < or = t', 0 < or = t' < or = t, the matrices A sub i (t') and A sub j (t') commute. It is also shown, by means of counter examples, that these assumptions cannot be weakened. Author

N72-30228* Harvard Univ., Cambridge, Mass.
CONTROLLABILITY OF NONLINEAR SYSTEM
Hector J. Sussman and Velimir Jurdjevic *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 61-94 refs (For availability see N72-30224 21-10)
CSCL 09C

The controllability of nonlinear systems of the form dx/dt = F(x,u) is studied. Criteria in terms of F and its derivatives at a point x which will give qualitative information about the sets attainable from x are established. The state variable x is assumed to take values in an arbitrary real analytic manifold. The results apply to nonsymmetric systems, and general information about the geometric structure of the attainable sets is obtained which shows they are practically submanifolds. It is shown that for a large class of manifolds accessibility implies strong accessibility, and for a still larger class controllability implies strong accessibility. The results are used to derive the classical controllability criteria for the system dx/dt = Ax + Bu. Author

N72-30229* Harvard Univ., Cambridge, Mass.
CONTROL SYSTEMS ON LIE GROUPS
Velimir Jurdjevic and Hector J. Sussmann *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 95-120 refs (For availability see N72-30224 21-10)
CSCL 09C

The controllability properties of systems are studied which are described by an evolution equation in an abstract Lie group G. The equation contains terms which are right-invariant vector fields on G. Necessary and sufficient conditions for a right-invariant system to be controllable are presented. A necessary condition is that the system have the accessibility property. This condition is also sufficient if G is connected and if either the system is homogeneous or G is compact. When neither of these two hold, accessibility (plus the connectedness of G) is not sufficient for controllability. In this case, sufficient conditions and a necessary condition are given, and a particular situation is singled out in which a necessary and sufficient condition can be obtained. Author

N72-30230* Harvard Univ., Cambridge, Mass.
LIE ALGEBRAS AND LINEAR DIFFERENTIAL EQUATIONS c19
Rojer W. Brockett and Abdolhossein Rahimi *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 121-128 refs (For availability see N72-30224 21-10)
(Grant NSF GS-14152)
CSCL 12A

Certain symmetry properties possessed by the solutions of linear differential equations are studied. This is accomplished by use of some basic ideas from the theory of finite dimensional linear systems together with the use of Lie algebraic methods in differential equation theory. Lie algebras and rational functions are discussed, and an application to stability is given. Author

N72-30231# Joint Publications Research Service, Arlington, Va.
PROGRAMMED INTEGRATED CIRCUIT WITH MOS STORAGE TRANSISTORS
A. S. Ginovker, A. A. Guzev, V. P. Konkov, G. L. Kuryshev, A. I. Mishin, S. P. Sinitsa, and B. G. Tepman 18 Aug. 1972 4 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), V. 17, no. 7, 1972
(JPRS-56808) Avail: NTIS HC $3.00

This report describes an integrated circuit of a universal cell based on ordinary MOS transistors and MOS transistors with memory (Storage transistors ZT). Author

N72-30232*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MONOLITHIC MICROCIRCUIT TECHNIQUES AND PROCESSES
Bobby W. Kennedy 15 Jun. 1972 59 p refs
(NASA-TM-X-64687) Avail: NTIS HC $5.00 CSCL 09C

Brief discussions of the techniques used to make dielectric and metal thin film depositions for monolithic circuits are presented. Silicon nitride deposition and the properties of silicon nitride films are discussed. Deposition of dichlorosilane and thermally grown silicon dioxide are reported. The deposition and thermal densification of borosilicate, aluminosilicate, and phosphosilicate glasses are discussed. Metallization for monolithic circuits and the characteristics of thin films are also included. Author

N72-30233*# Washington Univ., St. Louis, Mo. Lab. of Control Systems Science and Engineering.
SUFFICIENTLY INFORMATIVE FUNCTIONS AND THE MINIMAX FEEDBACK CONTROL OF UNCERTAIN DYNAMIC SYSTEMS Interim Scientific Report
Dimitri P. Bertsekas (Stanford Univ., Calif.) and Ian B. Rhodes Dec. 1971 15 p refs
(Grant NGL-22-009-124; Contract F44620-69-C-0116; Grant AF-AFOSR-1724-69; AF Proj. 7921)
(NASA-CR-127482; AFOSR-72-0364TR; AD-736810) Avail: NTIS HC $3.00 CSCL 09C

The problem of optimal feedback control of uncertain discrete-time dynamic systems is considered where the uncertain quantities do not have a stochastic description but instead are known to belong to given sets. The problem is converted to a sequential minimax problem and dynamic programming is suggested as a general method for its solution. The notion of a sufficiently informative function, which parallels the notion of a sufficient statistic of stochastic optimal control, is introduced, and conditions under which the optimal controller decomposes into an estimator and an actuator are identified. Author

N72-30234# California Univ., Berkeley. Lawrence Berkeley Lab.
COMPUTER PROGRAMS FOR ACCELERATORS AND

ELECTRONIC CIRCUIT DESIGNS
John S. Colonias Dec. 1971 59 p refs
(Contract W-7405-eng-48)
(LBL-564) Avail: NTIS

This publication deals specifically with computer programs relating to accelerator design and electronic circuit design. Each program is described in terms of an abstract, and a table of vital statistics summarizes the most important information relative to that program. Author (NSA)

N72-30235# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
RANDOM PROCESSES WITH CONTROL AND APPLICATIONS OPTIMIZATION Ph.D. Thesis - Paris Univ. [PROCESSUS ALEATOIRES A COMMANDE ET APPLICATIONS A L'OPTIMISATION STOCHASTIQUE]
Claude Aumasson 1972 228 p refs In FRENCH; ENGLISH summary
(ONERA-P-141) Avail: NTIS HC $13.50

A general mathematical model for stochastic discrete time control systems is presented. The probability effects on the feedback process and on the existence and construction of regular conditional probabilities are discussed. The results obtained lead to a new interpretation of the systems defined by transition probabilities, and are used to investigate, by dynamic programming, conditions for stochastic game problems with observations common to both players. In addition it is verified using two examples (linear, Gaussian, quadratic cost systems, and discrete Markovian systems) that the general theory permits new results to be found and known results optimized. ESRO

N72-30236# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugmechanik der Luftfahrzeuge.
INVESTIGATION OF THE TRANSFER BEHAVIOR OF MULTIVARIABLE SYSTEMS USING EIGENVECTORS [UNTERSUCHUNG DES UEBERTRAGUNGSVERHALTENS VON MEHRGROESSENSYSTEMEN MIT HILFE DER EIGENVEKTOREN]
Gerhard Rosenau Feb. 1972 68 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-28) Avail: NTIS HC $5.50; DFVLR, Porz-Wahn 15.50 DM

The behavior of linear dynamic multivariable systems, which is described by linear differential equations, can be separated into two parts. The first part, the eigen behavior, describes the motion of the system if the system is not at rest but no external disturbances act on it. The second part, transfer behavior, describes the motion of a system, originally at rest, on which external disturbances act. It is shown that the transfer behavior can be described using characteristics of the eigen behavior, e.g. the eigenvectors. This leads to the partial fraction representation of the transfer matrix. Control responses and integral criteria are deduced from this representation. The analytic results are applied to an example of flight mechanics. Author (ESRO)

N72-30237# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung. 2uft signalfluss-diagramme als hilfsmittel bei der behandlung von regelsystemen
SIGNAL FLOW GRAPHS AS AN AID IN CONTROL SYNTHESIS
Hans-Gerd Schlueter May 1972 78 p refs In GERMAN; ENGLISH summary
(DLR-MITT-72-13) Avail: NTIS HC $6.00; DFVLR, Porz 17 DM

Linear dynamic systems are described in the Laplace domain by linear algebraic equations which can be very easily and clearly represented by signal flow graphs. An extension to Coates method is described which allows for easier calculation and investigations of transfer functions, sensitivity, cross coupling, etc. The method and its advantages are presented from an engineer's point of view rather than in a rigorous mathematical manner. Author (ESRO)

N72-30238# California Univ., Berkeley. Electronics Research Center.
FEEDBACK CONTROL OF LINEAR SYSTEMS WITH DISTRIBUTED DELAY
J. K. Aggarwal 16 Nov. 1971 9 p refs Presented at the IFAC Symp. on the Control of Distributed Parameter Systems, Banff, Can., 21-23 Jun. 1971
(Grants AF-AFOSR-0766-67; AF-AFOSR-1488-68; NSF GK-1879)
(AD-740492; AFOSR-72-0902TR) Avail: NTIS CSCL 12/1

The problem of optimal control of linear systems containing lumped delay, given by differential difference equations, has been pursued by several authors. However, transportation lags are better described by distributed delays giving systems that are described by a set of coupled partial and ordinary differential equations. The lumped part of the system is described by ordinary differential equations and the distributed part of the system is described by partial differential equations. The lumped as well as distributed parts are subject to control. The present paper discusses the control of such systems with quadratic performance measures. Ricatti like equations are derived and a technique for their numerical solution is presented.
Author (GRA)

N72-30239# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR OPTIMIZATION OF AUTOMATIC CONTROL SYSTEMS
V. M. Ponomareva, Yu. V. Gorichev, V. I. Gorodetskii, V. N. Zakharov, and L. E. Kanarev 21 Jan. 1972 327 p refs Transl. into ENGLISH of the book "Nelineinaya Optimizatsiya Sistem Avtomaticheskogo Upravleniya" Moscow, Izv-vo Mashinastroyeniye, 1970 p 1-307
(AD-740184; FTD-MT-24-1058-71) Avail: NTIS CSCL 12/1

The book deals with optimization of control systems while they are being designed, using the Pontryagin principle of maximum, analytical methods, the theory of games, the principle of regularization of incorrectly formulated problems, deterministic and stochastic theories, and digital computers. Author (GRA)

N72-30240# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF FUNCTIONAL COMPATIBILITY OF VERSATILE CIRCUITS M.S. Thesis
James A. Muldowney Mar. 1972 57 p refs
(AD-742434; GE/EE/72-17) Avail: NTIS CSCL 09/5

An analysis was made of the set of relationships that exist between the electronic functions and the possible specifications of an arbitrary list of functions, for the purpose of developing a method of determining the compatibility of these functions in a single versatile circuit. A set of compatibility tests was devised. One of the tests was to determine the feasibility of fabricating a physical circuit that would perform with prescribed versatility. Two examples of circuit design were discussed, as were methods of extending these design principles to other circuits. Also, some techniques of optimization for individual functions were explored. Author (GRA)

N72-30241# California Univ., Los Angeles. School of Engineering and Applied Science.
OPTIMAL SCANNING CONTROL OF PARABOLIC SYSTEMS
Jean-Claude E. Martin Mar. 1972 67 p refs
(Grant AF-AFOSR-1547-68; AF Proj. 9769)
(AD-741916; UCLA-ENG-7219; AFOSR-72-1053TR) Avail: NTIS CSCL 12/1

The report is concerned with the optimal scanning control of a dynamical system whose behavior is described by a second-order parabolic differential equation. The control is given under the form of a single pointwise control moving along a trajectory in the interior of the system's spatial domain or on the boundary. The scanning movement of the control is described by the solution of a set of ordinary differential equations. The existence of optimal solutions for the problem involving the

minimization of a quadratic cost functional is established. Also, certain necessary conditions for optimality are given in the form of a nonlinear two-point boundary-value problem which, under additional conditions, admits a unique solution. Sufficient conditions for stability of the distributed system with a prescribed scanning feedback control are established, and a special one-dimensional optimal control problem is considered.
Author (GRA)

N72-30242# Naval Postgraduate School, Monterey, Calif.
OPTIMIZATION OF MULTIMODE SERVOMECHANISM WITH ADJUSTABLE INITIAL CONDITIONS M.S. Thesis
Luis Alberto Humphreys Rivera Dec. 1971 49 p refs
(AD-741119) Avail: NTIS CSCL 13/9

A study of a multimode third order instrument servomechanism is presented. Particular emphasis is placed on the effects of the initial condition of a compensating network, switched in as the system enters a linear operating mode, upon the behavior of the output. The optimum values for the initial condition as a function of velocity and acceleration of the servomotor is derived, using the integral squared error as a criteria. The results are confirmed with a computer simulation. Author (GRA)

N72-30243# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y.
ON THE COMPLEX S-PLANE DESIGN OF MULTIVARIABLE FEEDBACK CONTROL SYSTEMS
D. C. Youla and J. J. Bongiorno, Jr. Jan. 1972 40 p refs
(Contracts F30602-69-C-0053; F44620-69-C-0047)
(AD-740609; PIBEP-71-100; RADC-TR-72-10) Avail: NTIS CSCL 12/1

A body of literature has evolved for multivariable systems which is concerned with the placement of closed-loop eigenvalues and/or the question of decoupling. Attention is turned in the present paper to the broader question of realizing specified rational transfer matrices with a standard feedback configuration for linear, time-invariant, finite-dimensional, real, multivariable, dynamical plants. A complete and precise realization theory for asymptotically-stable plants is developed. Unstable plants with asymptotically-stable hidden modes are also discussed.
Author (GRA)

N72-30244# Brown Univ., Providence, R.I. Center for Dynamical Systems.
THE FLIP-FLOP CIRCUIT AS A NEUTRAL EQUATION
Marshall Slemrod 1972 14 p refs Presented at Park City Math. Conf. on Functional Differential Equations, Park City, Utah, 6-11 Mar. 1972
(Contract N00014-67-A-0191-0009; Grant DA-ARO(D)-31-124-71-G12; RR Proj. 003-01-01; NR Proj. 041-397)
(AD-740340) Avail: NTIS CSCL 09/5

The dynamics of a flip-flop circuit are formulated in terms of a distributed parameter model. It is then shown how the basic problem of flip-flop circuitry may be considered as a stability problem for a functional differential equation of neutral type.
Author (GRA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-30245*# Chrysler Corp., Huntsville, Ala.
AERONAUTICAL NOISE SUPPRESSION AT TRANSONIC MACH NUMBERS Final Report
George F. McCanless, Jr. 24 May 1972 34 p refs
(Contract NAS8-27503)
(NASA-CR-123810; HSM-R5-72) Avail: NTIS HC $3.75 CSCL 14B

The measurement of wind tunnel background pressure fluctuations in a Ludwig Tube is discussed. The measurements are to provide improved unsteady aerodynamic data for the design of aeronautical vehicles. The preliminary results of the facility calibration are presented. The noise generation mechanisms are discussed. The ability of conducting short duration acoustic tests is demonstrated, and amplitude and frequency data are given. Techniques of noise reduction are included. Author

N72-30246*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK, VOLUME 10 Progress Report, May - Jun. 1972
15 Aug. 1972 255 p refs
(Contract NAS7-100)
(NASA-CR-127762; JPL-TR-32-1526-Vol-10) Avail: NTIS HC $13.25 CSCL 22D

Progress on the Deep Space Network (DSN) supporting research and technology is reported. The objectives, functions and facilities of the DSN are described along with the mission support for the following: interplanetary flight projects, planetary flight projects, and manned space flight projects. Work in advanced engineering and communications systems is reported along with changes in hardware and software configurations in the DSN/MSFN tracking stations. F.O.S.

N72-30247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCES IN MEASURING TECHNIQUES FOR TURBINE COOLING TEST RIGS Status Report
Frank G. Pollack 1972 20 p refs Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972
(NASA-TM-X-68100; E-7016) Avail: NTIS HC $3.00 CSCL 14B

Surface temperature distribution measurements for turbine vanes and blades were obtained by measuring the infrared energy emitted by the airfoil. The IR distribution can be related to temperature distribution by suitable calibration methods and the data presented in the form of isotherm maps. Both IR photographic and real time electro-optical methods are being investigated. The methods can be adapted to rotating as well as stationary targets, and both methods can utilize computer processing. Pressure measurements on rotating components are made with a rotating system incorporating 10 miniature transducers. A mercury wetted slip ring assembly was used to supply excitation power and as a signal transfer device. The system was successfully tested up to speeds of 9000 rpm and is now being adapted to measure rotating blade airflow quantities in a spin rig and a research engine. Author

N72-30248*# Avco Government Products Group, Lowell, Mass. Systems Div.
DYNAMIC LOAD SIMULATOR Final Report, 24 Jun. 1971 - 24 May 1972
K. P. Joncas 23 Jun. 1972 237 p refs
(Contract NAS9-12016)
(NASA-CR-115760; AVSD-0076-72-RR) Avail: NTIS HC $14.00 CSCL 14B

Concepts and techniques for identifying and simulating both the steady state and dynamic characteristics of electrical loads for use during integrated system test and evaluation are discussed. The investigations showed that it is feasible to design and develop interrogation and simulation equipment to perform the desired functions. During the evaluation, actual spacecraft loads were interrogated by stimulating the loads with their normal input voltage and measuring the resultant voltage and current time histories. Elements of the circuits were optimized by an iterative process of selecting element values and comparing

the time-domain response of the model with those obtained from the real equipment during interrogation. Author

N72-30249*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ANECHOIC CHAMBER FACILITY FOR INVESTIGATING AERODYNAMIC NOISE
P. F. Massier and S. P. Parthasarathy 15 Sep. 1972 32 p
(Contract NAS7-100)
(NASA-CR-128038; JPL-TR-32-1564) Avail: NTIS HC $3.75 CSCL 14B

The aerodynamic noise facility was designed to be used primarily for investigating the noise-generating mechanisms of high-temperature supersonic and subsonic jets. The facility consists of an anechoic chamber, an exhaust jet silencer, instrumentation equipment, and an air heater with associated fuzl and cooling systems. Compressed air, when needed for jet noise studies, is provided by the wind tunnel compressor facility on a continuous basis. The chamber is 8.1 m long, 5.0 m wide, and 3.0 m high. Provisions have been made for allowing outside air to be drawn into the anechoic chamber in order to replenish the air that is entrained by the jet as it flows through the chamber. Also, openings are provided in the walls and in the ceiling for the purpose of acquiring optical measurements. Calibration of the chamber for noise reflections from the wall was accomplished in octave bands between 31.2 Hz and 32 kHz. Author

N72-30250*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTIMUM RUNWAY ORIENTATION RELATIVE TO CROSSWINDS
L. W. Falls and S. C. Brown Washington Sep. 1972 19 p refs
(NASA-TN-D-6930) Avail: NTIS HC #3.00 CSCL 01E

Specific magnitudes of crosswinds may exist that could be constraints to the success of an aircraft mission such as the landing of the proposed space shuttle. A method is required to determine the orientation or azimuth of the proposed runway which will minimize the probability of certain critical crosswinds. Two procedures for obtaining the optimum runway orientation relative to minimizing a specified crosswind speed are described and illustrated with examples. The empirical procedure requires only hand calculations on an ordinary wind rose. The theoretical method utilizes wind statistics computed after the bivariate normal elliptical distribution is applied to a data sample of component winds. This method requires only the assumption that the wind components are bivariate normally distributed. This assumption seems to be reasonable. Studies are currently in progress for testing wind components for bivariate normality for various stations. The close agreement between the theoretical and empirical results for the example chosen substantiates the bivariate normal assumption. Author

N72-30251# Grenoble Univ. (France).
SLOW EXTRACTION IN THE PROGRAM PLAN FOR IMPROVEMENT OF THE CERN SYNCHROCYCLOTRON Ph.D. Thesis
P. Mandrillon 1971 89 p refs In FRENCH
(NP-19180) Avail: AEC Depository Libraries

The present improvement program at the CERN synchrocyclotron has as its objectives the improvement of the number of protons accelerated per cycle, the repetition rate, and the beam quality. The object of the work described is the study of the systems which will be used in the improved machine for slow extraction of the beam with a high duty-cycle. The improvement program and the problem of extraction are first discussed in general. The components necessary for regenerative extraction are described in detail; these include the C, the slow extraction bobbin, and the regenerator. Other components of the extraction system are mentioned briefly. NSA

N72-30252# Western Environmental Research Lab., Las Vegas, Nev.
OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JANUARY THROUGH JUNE 1968
Jan. 1972 107 p
(MOU-SF-54-373)
(SWRHL-81-R) Avail: NTIS

During the period January through June 1968, eighteen announced nuclear tests were conducted in Nevada. Of these eighteen tests, three released radioactivity to the off-site environment. In addition, two operations of the Phoebus 2A nuclear rocket engine released radioactivity that was detected off-site. The highest gamma exposure rate measured at a populated location during this period was 65 mR/h at Clark Station, 16 miles west of Warm Springs, Nevada. This measurement was taken from an RM-11 permanent exposure rate recorder during cloud passage following Project Cabriolet on January 26. No water samples, collected from sources used for human consumption, were found to contain fresh fission products. Analysis of all sampling and surveillance data collected during this six-month period indicates the safety criteria established by the Atomic Energy Commission for the off-site population were not exceeded. Author (NSA)

N72-30253# Brookhaven National Lab., Upton, N.Y.
EFFECTS OF RANDOM ERRORS IN COIL LOCATIONS IN A HIGH-FIELD SUPERCONDUCTING ACCELERATOR
G. Parzen 25 Feb. 1972 8 p refs Sponsored by AEC
(BNL-16616) Avail: NTIS

The effects due to magnetic field perturbations caused by random errors in the coil positions in the bending magnets of a high-field superconducting accelerator are investigated. An error in the position of a particular current block in a bending magnet with a cosine current distribution will introduce multipole terms in the median plane magnetic field. Consideration of the random dipole term and its effect on the central orbit leads to a tolerance on the rms error in the location of the current blocks of about .0025 in. The effects of the random quadrupole term and the nonlinear terms are also considered. Author (NSA)

N72-30254# Rutherford High Energy Lab., Chilton (England).
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Oct. - 31 Dec. 1971
D. E. Gray, ed. Jan. 1972 20 p
(RHEL/R-239) Avail: AEC Depository Libraries; UK 30p

The use of the Nimrod accelerator beam for high energy physics research during the quarter is reported with a description of the unique track sensitive H target facility on the 1.5 m cryogenic bubble chamber. NSA

N72-30255# Royal Inst. of Tech., Stockholm (Sweden).
PARTIALLY IONIZED PLASMA CENTRIFUGE
B. Lehnert 2 Jan. 1972 18 p refs
(TRITA-EPP-72-1) Avail: AEC Depository Libraries

The partially ionized plasma centrifuge contains a neutral gas mixture of isotopes or elements, the motion of which is driven by a small amount of rotating plasma. The plasma motion is, in its turn, controlled by externally imposed electric and magnetic fields. Earlier investigations of the centrifuge are extended by an analysis of its operation conditions. It is shown that high rotational velocities, large separation degrees, and stable velocity profiles can be achieved at comparatively small power losses, within certain ranges of the parameters involved. Author (NSA)

N72-30256# European Southern Observatory, Hamburg (West Germany).
[RESEARCH ACTIVITIES] Annual Report 1970
[1972] 68 p
Avail: NTIS HC $5.50

The activities of the European Southern Observatory during

1970 are described. These include details of the 3.6 m Schmidt telescope projects, instruments and auxiliary equipment, buildings, and progress. Development work at Hamburg and Marseilles, and the Danish national 1.5 m telescope are also described.
ESRO

N72-30257# Army Construction Engineering Research Lab., Champaign, Ill.
COEFFICIENT OF LINEAR THERMAL EXPANSION OF EPOXY RESIN MORTARS Final Report
Robert F. Kemphues Apr. 1972 16 p refs
(AF Proj. 5224)
(AD-742212; CERL-TR-M-14) Avail: NTIS CSCL 01/5

Epoxy resin materials have been used since 1959 for the rapid repair of airfield pavements; some have been highly successful, others have failed. Some of the failures may be attributed to internal stress in the epoxy resin material. These stresses could be due to curing shrinkage or to the difference in coefficient of linear thermal expansion (oc sub l) between the epoxy patch and portland cement concrete. This study was undertaken to obtain information about the thermal expansion and curing shrinkage of epoxy resin mortars and concretes.
Author (GRA)

N72-30258# ARO, Inc., Arnold Air Force Station, Tenn.
DFVLR/AEDC COOPERATIVE THERMAL TEST 2 Final Report
N. C. Latture AEDC May 1972 26 p refs
(Contract F40600-72-C-0003)
(AD-740899; AEDC-TR-72-54) Avail: NTIS CSCL 14/2

A 10-cm-diam calibration sphere was tested in a space simulation chamber under two different background conditions. In one case, the sphere was enclosed in a black liquid-nitrogen (LN2) cooled shroud, while in the other case the sphere was exposed to the chamber walls which contain some sections not at LN2 temperature. In both cases, the sphere was allowed to reach a stabilized temperature while exposed to one solar constant. The final stabilized temperatures were only 2 F (1.1 C) different, indicating that the 'hot spots' in the chamber walls are not very significant for this type of test article. It is shown that they can be accounted for by computational techniques.
Author (GRA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N72-30259*# Stanford Univ., Calif. Thermoscience Div.
THE TURBULENT BOUNDARY LAYER ON A POROUS PLATE: AN EXPERIMENTAL STUDY OF THE FLUID MECHANICS FOR ADVERSE FREE STREAM PRESSURE GRADIENTS
P. S. Anderson, W. M. Kays, and R. J. Moffat May 1972 194 p refs
(Grant NGR-05-020-134)
(NASA-CR-127817; HMT-15) Avail: NTIS HC $11.75 CSCL 20D

An experimental investigation of transpired turbulent boundary layers in zero and adverse pressure gradients has been carried out. Profiles of: (1) the mean velocity, (2) the three intensities of the turbulent fluctuations, and (3) the Reynolds stress were obtained by hot-wire anemometry. The friction coefficients were measured by using an integrated form of the boundary layer equation to extrapolate the measured shear stress profiles to the wall.
Author

N72-30260*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SEARCH FOR THE EFFECT OF A HIGH FREQUENCY SPARK ON BOUNDARY-LAYER TRANSITION AT MACH 8.5
John B. Anders, William B. Boatright, and John R. Nayadley, Sr. Washington Aug. 1972 25 p refs
(NASA-TM-X-2610; L-8314) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation of the use of a high frequency spark to promote early boundary layer transition on a wind tunnel model was conducted at a Mach number of 8.5. Test variables included four electrode configurations, a frequency range from 10 kHz to 50 kHz, and various power inputs to the spark. The general conclusion obtained from this investigation is that over the parameter range, the high frequency spark is ineffective in inducing early transition at the test Mach number.
Author

N72-30261*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
STUDY OF LOW REYNOLDS NUMBER NOZZLE FLOWS, INCLUDING RADIAL PRESSURE GRADIENTS Final Report
William J. Rae Jul. 1972 66 p refs
(Contract NAS1-10806)
(NASA-CR-112112; CAL-A1-3108-A-1) Avail: NTIS HC $5.50 CSCL 20D

An analysis is presented of the laminar, axisymmetric flow in a nozzle, including both axial and radial variations of the pressure. The system of equations derived is believed to contain all of the terms necessary for describing the flow through a relatively sharp throat (i.e., one for which the longitudinal radius of curvature of the throat is comparable to, or less than, the transverse radius). A finite difference approximation of these equations is described, together with a computer program for finding numerical solutions. An instability was found in the starting solution; a series of attempts to eliminate this instability is described.
Author

N72-30262*# Pratt and Whitney Aircraft, East Hartford, Conn.
HIGH-LOADING LOW-SPEED FAN STUDY. 4: DATA AND PERFORMANCE WITH REDESIGN STATOR AND INCLUDING A ROTOR TIP CASING TREATMENT
K. G. Harley, P. A. Odegard, and E. A. Burdsall Jul. 1972 341 p refs
(Contract NAS3-10483)
(NASA-CR-120866; PWA-4326) Avail: NTIS HC $19.25 CSCL 20D

A single stage fan with a rotor tip speed of 1000 ft/sec(304.8 m/sec) and a hub-to-tip ratio of 0.392 was retested with a redesigned stator. Tests were conducted with uniform inlet, tip-radial, hub-radial, and circumferential inlet distortions. With uniform inlet flow, stall margin was improved 12 percentage points above that with the original stator. The fan demonstrated an efficiency of 0.883 and a stall margin of 15 percent at a pressure ratio of 1.488 and a specific flow of 41.17 lb/sec/sq ft. Tests were also made with a redesigned casing treatment consisting of skewed slots over the rotor blade tips. This casing treatment gave a 7 percentage point improvement in stall margin when tested with tip radial distortion (when the rotor tip initiated stall). Noise measurements at the fan inlet and exit indicate no effect from closing the stator 10 degrees, nor were there measurable effects from adding skewed slots over the blade tips.

N72-30263*# Scientific Translation Service, Santa Barbara, Calif.
HEAT TRANSFER IN LAMINAR SUPERSONIC BOUNDARY LAYER WITH BLOWING OF A LIGHT GAS WITH DESIRED PRESSURE AND HEAT DISTRIBUTION
W. Wuest Washington NASA Aug. 1972 20 p refs Transl. into ENGLISH from the publ. "Jahrbuch 1965 der WGL" 1965 p 211-216 Presented at 6th European Aviation Conf., Munich, 1-4 Sep. 1965

(Contract NASw-2035)
(NASA-TT-F-14515) Avail: NTIS HC $3.00 CSCL 20D

A generalized technique for the determination of the heat transfer and the distribution of velocity, temperature and concentration in a given two-substance boundary layer is presented. With this technique a difference quotient is used in place of the conductivity along the wall, while an iteration procedure is employed for accurately solving the differential equations for a direction perpendicular to the wall. The blowing of a light gas caused by the evaporation of a liquid film or the sublimation of the wall material results in a gas mixture in the wall boundary layer. This gas mixture has an appreciable effect on heat conduction. Author

N72-30264*# Scientific Translation Service, Santa Barbara, Calif.
NUMERICAL STUDY OF THE INFLUENCE OF THE WING TIP SHAPE ON THE VORTEX SHEET ROLLING UP
C. Rehback Washington NASA Aug. 1972 6 p refs Transl. into ENGLISH from Rech. Aerosp. (Chatillion-sous-Bayneaux), 1971-1975 p 367-368
(Contract NASw-2035)
(NASA-TT-F-14538) Avail: NTIS $3.00 CSCL 20D

A computer program to analyze the wing tip vortex distribution as a function of wing tip shape is presented. The wing and the sheet are replaced by a vortex surface. The continuous vortex distribution over the surface is replaced by a discrete vortex distribution, which is a horseshoe distribution of finite magnitude and is placed over the wing only. The sheet appears in the form of a series of vortex threads which emanate as moderate incidence angles from the leading edge to the wing tip. Starting with the given initial position, the threads evolve during the course of an iteration calculation and assume equilibrium positions parallel to the average velocity over the sheet. Author

N72-30265# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS OF SUPERCAVITATING FLOW AROUND SLENDER PROFILES IN A BOUNDED STREAM
V. M. Roman [1972] 8 p refs Transl. into ENGLISH from Gidromekhan. (Kiev), no. 17, 1971 p 22-30
Avail: NTIS HC $3.00; National Translation Center, John Crerar Library, Chicago, Ill. 60616

An analysis of the supercavitating flow around slender profiles in a bounded stream is presented. The dimensions of the profile are established and the rectangular coordinates are defined. The acceleration potential or the pressure satisfies the Laplace equation for a linearized incompressible stream. Mathematical models are developed to support the theoretical considerations. Author

N72-30266# Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF HYDRODYNAMIC TUNNEL WALLS ON SUPERCAVITATING FLOW AROUND PROFILES
I. I. Efremov [1972] 9 p refs Transl. into ENGLISH from Gidromekhanika (Kiev), no. 17, 1971 p 15-22
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The use of conformal mapping to solve problems concerning cavitating flow around slender bodies in a hydrodynamic tunnel is discussed. Tunnel wall influence on the hydrodynamic characteristics of the cavitating bodies is also discussed. E.H.W.

N72-30267*# Old Dominion Univ. Research Foundation, Norfolk, Va.
AN EXPERIMENTAL INVESTIGATION OF A COLD JET EMITTING FROM A BODY OF REVOLUTION INTO A SUBSONIC FREE STREAM
Donald S. Ousterhout Washington NASA Aug. 1972 167 p refs
(Grant NGL-47-003-039)
(NASA-CR-2089) Avail: NTIS HC $3.00 CSCL 20D

An experimental program was undertaken to determine the pressure distribution induced on aerodynamic bodies by a subsonic cold jet exhausting normal to the body surface and into a subsonic free stream. The investigation was limited to two bodies with single exhaust jets a flat plate at zero angle of attack with respect to the free-stream flow and a cylinder, fitted with a conical nose, with the longitudinal axis alined with the free-stream flow. Experimental data were obtained for free-stream velocity to jet velocity ratios between 0.3 and 0.5. The experimental data are presented in tabular form with appropriate graphs to indicate pressure coefficient contours, pressure coefficient decay, pitching-moment characteristics, and lift characteristics. Author

N72-30268*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OUTLET BAFFLES: EFFECT ON LIQUID RESIDUALS FROM ZERO-GRAVITY DRAINING OF HEMISPHERICALLY ENDED CYLINDERS
Eugene P. Symons Washington Sep. 1972 20 p refs
(NASA-TM-X-2631; E-6986) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation was conducted to study the relative effectiveness of various outlet baffles in reducing liquid residuals resulting from the draining of hemispherically ended cylindrical tanks in a weightless environment. Three different baffles were employed. The relative effectiveness of each baffle was determined by comparing the results obtained, in the form of liquid residuals, with results for an unbaffled tank. Data indicate that all the baffles tested reduced residuals. Reductions betweem 10 and 60 percent were obtained, depending on baffle geometry and outlfow Weber number. Author

N72-30269*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARTICLE TRACKABILITY CONSIDERATIONS FOR LASER DOPPLER VELOCIMETRY
Allen M. Karchmer Washington Sep. 1972 22 p refs
(NASA-TM-X-2628; E-6992) Avail: NTIS HC $3.00 CSCL 20D

The technique for calculating single particle trackability in a fluid flow in terms of rms velocities is discussed. The general equation for the motion of a single particle as a response to a fluid flow driving force is presented, and a criterion for greatly simplifying the governing equation is developed. It is shown that in the case of large particle- to fluid-density ratio and low frequency fluid motion compared to the natural time constant of the particle response, the governing equation can be reduced to a simple balance of inertia force and linear viscous drag (i.e., Stokes drag). Author

N72-30270# Joint Publications Research Service, Arlington, Va.
SUPERSONIC FLOW OF HOT GASES AROUND BODIES
P. I. Chushkin 22 Aug. 1972 11 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (USSR), v. 5, no. 2, 1969
(JPRS-56832) Avail: NTIS HC $3.00

The supersonic steady-state symmetrical flow of a hot gaseous mixture around a flat body or a body of rotation is the described solution of the problem obtained by the numerical characteristics method. Author

N72-30271# Joint Publications Research Service, Arlington, Va.
A TURBULENT IMMERSED WALL JET OF AIR ON A BURNING GRAPHITE SURFACE
E. Volchkov and P. V. Nikitin 23 Aug. 1972 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 1, 1971
(JPRS-56849) Avail: NTIS HC $3.00

A wall turbulent boundary layer in an immersed jet of air, distributed along a burning graphite wall is investigated. A method of calculation based on the solution of integral equations for impulses and energy with the utilization of the conservative

properties of a wall turbulent boundary layer was adopted to investigate the thermal-mass exchange and friction in the boundary layer. Author

N72-30272# Joint Publications Research Service, Arlington, Va.
CALCULATION OF PROFILE DRAG AT HIGH GAS VELOCITIES AND IN THE PRESENCE OF HEAT TRANSFER
L. G. Stepanyants 22 Aug. 1972 10 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Leningrad), no. 248, 1965, p 88-92
(JPRS-56834) Avail: NTIS HC $3.00

The values of profile drag at high gas velocities and in the presence of heat transfer were calculated employing the Squire and Yound method. Author

N72-30273# Joint Publications Research Service, Arlington, Va.
THE INFLUENCE ON HEAT EXCHANGE OF FREEZING CHEMICAL REACTIONS IN A NONEQUILIBRIUM LAMINAR BOUNDARY
V. G. Voronkin 24 Aug. 1972 5 p refs Transl. into ENGLISH from Izvest. Akad. Nauk SSSR, Mech. Zhidk. Gaza (USSR), no. 6, 1970 p 127-129
(JPRS-56839) Avail: NTIS HC $3.00

The report shows that for a nonequilibrium boundary layer on a wall with a finite catalytic activity, the absolute value of heat flow and the ratio of heat flows q/q sub o depend on the thermo-chemical state of gas in the boundary layer and the degree of surface catalizability. Author

N72-30274# Joint Publications Research Service, Arlington, Va.
COMPUTING THE LAMINAR BOUNDARY LAYER ALONG THE FLOW LINE OF FRONTAL SURFACE OF A SEGMENTED BODY IN A SUPERSONIC GAS FLOW
S. N. Seliverstov 18 Aug. 1972 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 4, 1968 p 109-114
(JPRS-56807) Avail: NTIS HC $3.00

Equations are given of a laminar boundary layer along a flow line lying in the symmetry plane of a certain streamlined body. Results are presented of a numerical calculation of the boundary layer along the flow line of the frontal part of a spherical segment. It is shown that the maximal values of heat flows and frictional stress on the flow line occurs in all cases in the vicinity of an angular point on the windward side of the segment, where delta attains its minimal value. Author

N72-30275*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRESSURE-FLUCTUATION INPUTS AND RESPONSE OF PANELS UNDERLYING ATTACHED AND SEPARATED SUPERSONIC TURBULENT BOUNDARY LAYERS
Charles F. Coe and Wei J. Chyu Sep. 1972 50 p refs
(NASA-TM-X-62189) Avail: NTIS HC $4.50 CSCL 20D

Results are presented for an investigation of surface pressure fluctuations and response of panels underlying attached and separated turbulent boundary layers and shock waves. Tests conducted at transonic and supersonic Mach numbers to 3.6 to study the pressure fields. Assorted fixed edge flat panels were tested at Mach numbers from 1.6 to 3.6 in attached and completely separated flow fields, and also in mixed flow with a step-induced shock wave oscillating on the panels. The surface pressure fluctuations are described in terms of broadband rms, spectral density, and spatial correlation information. The effectiveness of parameters for scaling the pressure fluctuations is also illustrated. Measurements of the amplitude and strain response of the panels are compared with response computations by the normal mode method of analysis. Author

N72-30276*# New York Univ., N.Y. Aerospace Lab.
INTERACTION BETWEEN AN UPSTREAM FACING WALL JET AND A SUPERSONIC STREAM
Renzo Piva 25 Jan. 1972 36 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal, Jan. 1973
(Grant NGR-33-016-131)
(NASA-CR-112165) Avail: NTIS HC $4.00 CSCL 20D

The flow field resulting from the interaction of an upstream facing wall jet with a supersonic counterflowing stream has been investigated. A flow field model and the main parameters governing the phenomena were determined from quantitative and qualitative experimental observations. Experimental results for different ranges of the main parameters are presented. A theoretical analysis was performed to describe the flow field in the mixing region between the two counterflowing streams. The results obtained by applying a locally similar solution compare favorably with the experimentally measured values. Large values of jet penetration were obtained with a high subsonic or low supersonic jet; large interaction forces are characteristics of higher supersonic injections. For the case of large penetration the cooling effectiveness presented as a function of the main parameters indicates the possibility of interacting cooling applications. Author

N72-30277# Sandia Labs., Albuquerque, N.Mex.
CHEMICALLY REACTING VISCOUS FLOW PROGRAM FOR MULTI-COMPONENT GAS MIXTURES
F. G. Blottner, Margaret Johnson, and Molly Ellis Dec. 1971 316 p refs Sponsored by AEC
(SC-RR-70-754) Avail: NTIS

The methods used for solving the laminar boundary layer equations are presented and a detailed description of the resulting computer program is given. This program can be used to calculate the thin viscous shock layer at a stagnation point or the boundary layer flow along an arbitrary body shape. The gas model is of a general form where the mixture can consist of as many as 30 species with finite reactions occurring. Several boundary conditions at the surface are available as options in the program to account for material ablation. Author

N72-30278# Institutt for Atomenergi, Kjeller (Norway).
THERMAL NONEQUILIBRIUM AND BUBBLE SIZE DISTRIBUTIONS IN AN UPWARD STEAM WATER FLOW
Oddrjoern Sandervag Oct. 1971 106 p refs
(KR-144) Avail: AEC Depository Libraries

A usual assumption in steam-water flow descriptions is that thermal equilibrium is established without time delay. A basic hypothesis that the two phases are generally not in a thermal equilibrium state is described. An equation for vapor formation is introduced. A correlation for steam production from a heating surface due to bubble growth and detachment is derived. The experiments are performed in an upward, vertical steam-water flow at four pressure levels, ranging from 20 to 49 bar. Significant liquid superheat in fully developed boiling, as well as subcooled void, is observed. Bubble diameter distributions are determined by analysis of the signals from the void probe. Applications of the distributions are indicated. Mass transfer coefficients for the bubble clouds are calculated based on single bubble growth. Author (NSA)

N72-30279# Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research.
SHOCK WAVE IN A LONGITUDINAL MAGNETIC FIELD
T. A. El-Khalafawy, M. M. Masoud, and A. I. Zemskov 1971 17 p refs
(UAREE-120) Avail: AEC Depository Libraries

The longitudinal magnetic field effect on the propagation velocity and ionizing shock wave structure was studied. The quasi-stationary magnetic field amounted to 7 kG. The hydrogen pressure varied in the range 0.003 to 0.1 mtorr. The shock tube diameter and length were 4 cm and 80 cm, respectively. NSA

N72-30280# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CALCULATION METHOD OF THE SUPERCRITICAL FLOW

OVER AN AIRFOIL IN A NOZZLE [METHODE DE CALCUL DE L'ECOULEMENT SUPERCRITIQUE SUR UN PROFIL PLACE DANS UNE TUYERE]
Pierre Labal 1972 26 p refs In FRENCH; ENGLISH summary
(ONERA-NT-189) Avail: NTIS HC $3.50

A time-dependent method is developed to compute supercritical flow over an airfoil or an axisymmetric body in a nozzle. An explicit second-order accurate difference scheme, similar to a two-step Richtmyer scheme is set up. The artificial viscosity term is made to depend upon a parameter which is a function of time and spatial variables. Transformed spatial variables are used in order to increase the mesh points in the vicinity of the shock wave and to simplify the treatment of the boundary conditions on the airfoil. Results are presented for supercritical flows over a biconvex airfoil for various values of the specific heat ratio and of the upstream Mach number. Good agreement is found with results previously obtained using a time-dependent method, and Spreiter's transonic similarity law is verified with a very good accuracy. Author (ESRO)

N72-30281# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
INVESTIGATIONS ON THE FLOW IN A CONSTANT AREA DUCT WITH HEAT TRANSFER AND FRICTION Ph.D. Thesis - Brunswick Univ. [UNTERSUCHUNGEN ZUR ISOPLANEN STROEMUNG MIT WAERMEAUSTAUSCH UND REIBUNG]
Walter Alvermann Feb. 1972 122 p refs In German; ENGLISH summary
(DLR-FB-72-32) Avail: NTIS HC $8.25; DFVLR, Porz 27,50 DM

The flow processes of cooled and heated subsonic and supersonic flow in constant-area-ducts were studied starting from a theoretical work which provided a diagram and using the analogy between momentum and heat-transfer in turbulent flow with simplifying assumptions. Experimental investigations are described for the special case of a cooled subsonic flow for which theory predicts a thermal choking when approaching the sonic velocity. A method for determining the flow parameters is derived. The investigations include the calculation of the heat transfer to the wall of the duct to determine the wall temperature and of the friction coefficients of the flow. The results of the experiments are compared with the theoretical curves in the diagram. The application of a correction factor makes possible a good agreement between the experimental values and theory for a wide range of pressures, temperatures and flow rates and demonstrates the usefulness of the diagram. Author (ESRO)

N72-30282# Waterloopkundig Laboratorium, Delft (Netherlands).
NUMERICAL METHODS FOR THE SOLUTION OF DIFFUSION ADVECTION EQUATIONS
J. Siemons Dec. 1970 50 p refs
(Publ-88) Avail: NTIS HC $4.50

For the solution of a two-dimensional diffusion-advection equation, finite difference methods were used. In these methods, the time derivative was discretized in t-direction as well as in x-direction (the flow direction). The resulting system of linear equations is solved by means of an elimination method. A measure for the accuracy is the truncation error and the deformation factor. These quantities give a qualitative idea of the errors introduced by the finite difference methods.
Author (ESRO)

N72-30283# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE EFFECT OF FLOW NONUNIFORMITIES ARISING FROM A SOURCE-LIKE HYPERSONIC NOZZLE FLOW ON TWO-DIMENSIONAL AND AXISYMMETRIC TEST BODIES
K. S. Nagaraja, William G. Reinecke (Avco Corp., Wilmington, Mass), and M. Shirazi (Dayton Univ. Research Inst., Ohio) Feb. 1972 53 p refs
(AF Proj. 7064)
(AD-741782; ARL-72-0023) Avail: NTIS CSCL 20/4

The effect of free stream Mach number gradients on pressures measured on slender, sharp-nosed bodies in a hypersonic wind tunnel is investigated. Corrections to the measured surface pressures are obtained using the Mach number gradient as an expansion parameter in a perturbation procedure. The theory is not restricted to very high Mach number flows, nor is it limited to the case where the ratio of the specific heats is very nearly unity. The perturbed flow quantities such as surface pressure perturbation due to the flow nonuniformities are derived as functions of the distances measured along streamlines and normal to the streamlines. The results of wind tunnel measurements are in agreement with the theory. GRA

N72-30284# Meteorology Research, Inc., Altadena, Calif.
TRANSPORT AND STABILITY OF A VORTEX WAKE Final Report
Ivar H. Tombach 17 Apr. 1972 74 p refs
(Contract F44620-70-C-0032; AF Proj. 9781)
(AD-742305; MRI-72-FR-1010; AFOSR-72-1159TR) Avail: NTIS CSCL 20/4

The influence of the atmospheric environment on the transport and decay of a trailing vortex wake has been studied analytically and experimentally during a two-year long research program. An analytical model describing the descending motion of an entraining wake in a stably stratified atmosphere has been developed. This model was compared with several other recent theoretical analyses and with limited experimental observations in order to determine the validity. A flight test program was carried out in which the smoke-marked vortices behind a lightplane were observed in an atmosphere of measured turbulence and stratification. The descending motion of the wake was also measured, as was the vortex spacing during the descent. The results of these tests are compared with those of some small-scale model experiments and of some large aircraft flight tests. GRA

N72-30285# Oceanics, Inc., Plainview, N.Y.
THE VORTEX CORE JET NEAR THE POINT OF GENERATION Final Report
Theodore R. Goodman Apr. 1972 25 p refs
(Contract F44620-70-C-0106; AF Proj. 9781)
(AD-742311; Rept-72-91; AFOSR-72-1158TR) Avail: NTIS CSCL 20/4

Near the point of generation of a wing tip vortex the axial velocity in the vortex core can be considerably greater than the free stream velocity. The present analysis describes the velocity field under these circumstances and shows that a self-similar solution exists that satisfies all the boundary conditions. The resulting two-point boundary value problem is solved on a digital computer and shows qualitative agreement with experiments.
Author (GRA)

N72-30286# Stanford Univ., Calif. Dept. of Applied Mechanics.
SUBMERGED CYLINDRICAL SHELLS SUBJECTED TO MOVING LOADS Interim Report
J. E. Russell and G. Herrmann Mar. 1972 27 p refs Prepared in cooperation with S. Dak. School of Mines and Technol., Rapid City
(Contract N00014-67-A-0112-0065; Grant AF-AFOSR-1905-70; AF Proj. 9782)
(AD-742307; SUDAM-72-2; AFOSR-72-0251TR) Avail: NTIS CSCL 20/4

An axially symmetric pressure wave expanding with constant speed along an infinitely long cylindrical shell submerged in an inviscid, incompressible fluid of infinite extent is considered. Shell-fluid interaction problems involving loads moving with constant speed have been solved by transforming to a coordinate system moving with the wave speed at the wave front. Such solutions are referred to as steady-state because an observer traveling with the wave speed would presumably see a constant pattern both ahead and behind the wave front. In this paper, the complete initial value problem is formulated and the solution is

presented as the sum of a complementary and a particular solution. The steady-state solution is also constructed.
Author (GRA)

N72-30287# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTAL STUDIES OF RADIATION-DRIVEN PROPAGATION IN A RADIATING GAS Final Report
Walter G. Vincenti and Donald Baganoff Sep. 1971 5 p refs
(Contract N00014-67-A-0112-0017)
(AD-742097) Avail: NTIS CSCL 20/4

The aim of the work was to conduct basic experimental studies of the interaction of radiative transfer and gas motion by making measurements of radiatively driven acoustic waves in a gas in a closed container. Very briefly summarized are experiments in carbon monoxide and carbon dioxide under conditions both of vibrational equilibrium and vibrational nonequilibrium. Author (GRA)

N72-30288# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
NUMERICAL STUDIES IN GAS DYNAMICS Final Scientific Report, 15 Apr. 1971 - 14 Apr. 1972
G. A. Bird 15 Apr. 1972 7 p refs
(Grant AF-AFOSR-0915-67; AF Proj. 9783)
(AD-742312; AFOSR-72-1153TR) Avail: NTIS CSCL 20/4

A review of the most recent developments in and applications of the direct simulation Monte Carlo method for the numerical solution of problems in rarefied gas dynamics. A new programming system has been devised for multi-dimensional flows which allows a single program to deal with flows of arbitrary geometry. One such program has been developed for two-dimensional or axially symmetric flows and another for three dimensional flows. The possible application of these programs to continuum flows is examined. Other developments include a program for the study of the internal structure of shock waves in a dissociating gas and the production of additional sequences of a color movie to illustrate rarefied gas flows on a molecular scale. Author (GRA)

N72-30289# Technology, Inc., Dayton, Ohio.
LAMINAR HYPERSONIC INTERACTING BOUNDARY LAYERS: SUBCRITICAL BRANCHING IN THE STRONG INTERACTION REGIME Final Report
M. J. Werle and D. L. Dwoyer (ARL) Wright-Patterson AFB, Ohio ARL Feb. 1972 56 p refs
(Contract F33615-71-C-1463; AF Proj. 7064)
(AD-741759; ARL-72-0011) Avail: NTIS CSCL 20/4

Boundary layers interacting with a hypersonic mainstream over hot and cold wall flat plates are solved numerically using an implicit finite difference scheme. Attention is given to the details of the initialization procedure needed to allow subcritical boundary-layer development. The exact starting model is investigated in detail and applied over a representative range of wall temperatures. Solutions are obtained with either monotomically increasing or decreasing pressure levels depending on the sign of a single free constant. Author (GRA)

N72-30290# Air Force Armament Lab., Eglin AFB, Fla.
AERODYNAMIC CHARACTERISTICS OF BASIC NOSE CYLINDER BODIES FOR LARGE RANGES OF ANGLE OF ATTACK Final Report, Oct. 1969 - Jun. 1971
Robert E. Kellock and Percy H. Miller Jun. 1971 60 p refs
(AD-742232; AFATL-TR-71-67) Avail: NTIS CSCL 16/3

The existing methods of predicting aerodynamic characteristics for basic blunt-based bodies of revolution are reviewed and assessed. Utilizing the more accurate methods, a digital computer program was developed which uses numerical techniques, thus avoiding less accurate simplifying assumptions. This new approach provides reasonable accuracy in predicting the normal force and moment coefficients of basic model combinations for angles of attack ranging from zero to 90 degrees. This accuracy in prognosis also includes freestream Mach numbers ranging from subsonic to hypersonic. Author (GRA)

N72-30291# North American Rockwell Corp., Columbus, Ohio. Aircraft Div.
EXPLORATORY INVESTIGATION OF PULSE BLOWING FOR BOUNDARY LAYER CONTROL Technical Report, Apr. 1971 - Jan. 1972
T. E. Oyler and William E. Palmer 15 Jan. 1972 84 p refs
(Contract N00014-71-C-0259; NR Proj. 215-183)
(AD-742085; NR72H-12) Avail: NTIS CSCL 20/4

Results of an experimental investigation is described to determine the feasibility of intermittent jet blowing to achieve reduced air flow rates as compared with steady blowing for prevention or delay of flow separation on a trailing edge flap. The jet was directed tangential to the flap surface in a downstream direction. The results show that significant reductions in mass flow rate could be realized at a given flap lift effectiveness. Author (GRA)

N72-30292# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
EXCITATION OF A TURBULENT BOUNDARY LAYER BY PULSES
Hajime Fujita and Leslie S. G. Kovasznay Jan. 1972 41 p refs
(Contract N00014-67-A-0163-0002)
(AD-742450) Avail: NTIS CSCL 20/4

A low duty cycle periodically pulsed jet was injected into a zero pressure gradient turbulent boundary layer through a small hole in the wall in order to simulate or stimulate the ejections of turbulent bursts from the active region near the viscous sublayer. The method of periodic sampling, in synchronism with the pulsed jet action was employed to detect the periodic part of the flow field disturbed by the injected jet. The trajectory through the turbulent boundary layer, the transporting velocity and the decay of the resulting disturbance were all measured in detail. A fewer exploratory runs were made with injections from very large diameter orifice in order to shoot the disturbance through the entire boundary layer thickness. In that case, higher Reynolds stress value was observed in the disturbed region when comparing with the value in a normal turbulent boundary layer.
Author (GRA)

N72-30293# Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
AN EXACT LINEAR LIFTING-SURFACE THEORY FOR A MARINE PROPELLER IN A NONUNIFORM FLOW FIELD Final Report
S. Tsakonas, W. R. Jacobs, and M. R. Ali Feb. 1972 56 p refs
(Contract N00014-67-A-0202-0018; DL Proj. 3666/113)
(AD-742455; SIT-DL-1509) Avail: NTIS CSCL 20/4

The mathematical model used in previous Davidson Laboratory adaptations of linearized unsteady lifting surface theory to marine propellers has been revised by removing the so-called staircase approximation of the blade wake and replacing it by an exact helicoidal blade wake. A new numerical procedure and program based on the present model has been developed to evaluate the steady and unsteady blade loading distributions, which are used to determine the bearing forces and moments. Systematic calculations of these forces and moments for a series of propellers show better agreement on the whole with experimental measurements than did the earlier calculations for the same series. In addition, the chordwise loading distributions are much smoother than obtained previously. However, the quantitative improvement must be weighed against the considerable increase in computer time over the old method.
Author (GRA)

N72-30294# RAND Corp., Santa Monica, Calif.
STOCHASTIC PROCESSES IN HEAT AND MASS TRANSPORT
Vincent A. LoDato Jan. 1972 49 p refs Submitted for publication
(AD-742400; P-4756) Avail: NTIS CSCL 20/4

With the classic work of Reynolds the theory of turbulence has its foundation, and since then a host of papers came forth to

describe this phenomenon, which is found in most fluids. The transport of mass and heat in a turbulent environment is an extremely important problem today. In order to understand how a pollutant, whether it be an active or inactive material or heat, is being transported, it becomes imperative to understand how to treat stochastic differential and/or integral equations. In the paper the author reviews the methods for solving such equations. The author considers the velocity field and the Navier-Stokes equations and discusses the mathematical problems associated with it. Some of the recent and famous theories of turbulence are mentioned. Author (GRA)

N72-30295# ARO, Inc., Arnold Air Force Station, Tenn.
CLUSTER FORMATION IN FREE JET EXPANSIONS Final Report, Apr. 1970 - Apr. 1971
A. B. Bailey, M. R. Busby, and R. Dawbarn AEDC Apr. 1972 129 p refs
(Contract F40600-72-C-0003)
(AD-740898; AEDC-TR-72-32) Avail: NTIS CSCL 07/4

An aerodynamic molecular beam has been used in an attempt to develop criteria for the determination of the onset of condensation in free-jet expansions of various gases. Measurements have been made of the total, monomer, dimer, trimer, etc., beam intensity and velocity distribution as a function of source pressure for the following conditions: (1) sonic orifice diameters of 0.0147, 0.0386, and 0.1245 cm, (2) 15-deg semiangle conical nozzle with a 0.111-cm-diam throat, (3) source temperatures from 185 to 430 K, (4) source pressures ranging from 5 to 10,000 torr, (5) argon, nitrogen, nitric oxide, sulphur dioxide, carbon dioxide, and krypton, and (6) 22 K skimmer and collimator surfaces. Author (GRA)

N72-30296# Naval Postgraduate School, Monterey, Calif.
ADDED MASS OF A CIRCULAR CYLINDER UNDER A FREE SURFACE M.S. Thesis
R. L. Gosselin Dec. 1971 76 p refs
(AD-741139) Avail: NTIS CSCL 20/4

When a circular cylinder is immersed in a fluid of infinite extent and oscillated in such a manner that drag effects are negligible, the closed form solution gives an added mass coefficient of 1.0. However, if boundaries are placed in proximity to the cylinder, and the cylinder is oscillated parallel to the boundary, the added mass varies from the classical result, and the forces are dependent upon the boundaries as well as the frequency. The study experimentally determined the total force on such a cylinder in proximity to an impermeable bottom surface under a free surface and related this force to the added mass coefficient. A computer program was used and the results are presented graphically as a function of dimensionless parameters. GRA

N72-30297# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
LOW DENSITY HIGH TEMPERATURE GAS DYNAMICS Final Scientfic Report, 1 May 1970 - 31 Oct. 1971
J. J. Smolderen and J. F. Wendt 31 Jan. 1972 55 p refs
(Grant EOOAR-0081-70; AF Proj. 9783)
(AD-740989; AFOSR-72-1005TR) Avail: NTIS CSCL 20/4

The hypersonic flow over a flat plate with sharp leading edge has been studied extensively during the past ten years, particularly since a proper description of the kinetic, transitional, and possibly the early stages of the merged-layer regimes cannot be provided by the Navier-Stokes equations of continuum gas dynamics. Experimental evidence and the results of certain approximate theoretical treatments have therefore been employed to construct a variety of flow models for these non-continuum regimes. Author (GRA)

N72-30298# Naval Postgraduate School, Monterey, Calif.
SOME MEASUREMENTS OF SURFACE-WAVE DECAY DUE TO UNDERWATER TURBULENCE
Theodore Green, Herman Medwin, and James E. Paquin Jan. 1972 24 p refs
(AD-741074; NPS-61MD72101A) Avail: NTIS CSCL 20/4

The decay of both wind- and paddle-generated surface capillary-gravity waves passing through a zone of turbulent water was measured. The results point to a dissipative decay mechanism that is proportional to wave amplitude squared, with a proportionality constant which varies as frequency to the fifth power. Author (GRA)

N72-30299# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYTICAL STUDY OF CONFINED LAMINAR AND TURBULENT JET MIXING WITH BOUNDARY LAYER GROWTH M.S. Thesis
Lynn A. Atkinson Mar. 1972 74 p refs
(AD-742116; GAM/AE/72-8) Avail: NTIS CSCL 20/4

An analytical study of laminar and turbulent jet mixing in a straight parallel wall channel was made using three different initial velocity profiles. The system of governing equations describing the flow was solved using an implicit finite-difference technique. The governing equations were reduced to a set of linear algbraic equations that were solved simultaneously on a digital computer. The development of the axial velocity profiles and the jet mixing spreading rates for the three cases are compared. For the laminar cases, the momentum flux increased when a negative pressure gradient was present. For the turbulent jet mixing cases, the boundary-layer growth is laminar, and the analysis is restricted to the initial region. Author (GRA)

N72-30300# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXPERIMENTAL STUDY OF THE EFFECT OF FLAP SETBACK AND GAS TEMPERATURE ON THE LIFT OF A JET DEFLECTION FLAP M.S. Thesis
Harold M. Stewart Mar. 1972 93 p refs
(AD-741583; GAM/ME/72-6) Avail: NTIS CSCL 20/4

An investigation was conducted on the effect of setback, combined with elevated gas temperatures, on Coanda attachment to a curved plate. The tests used a rectangular convergent nozzle. Chamber temperatures ranged from ambient to 1100 F. Turning efficiency and surface pressure distribution were analyzed. Air flow patterns over a flap on a 1/6th scale propulsive wing model were analyzed. Nonuniform air flow is discussed with regard to flow separation. Author (GRA)

N72-30301# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
MEASUREMENT OF THE CAVITATION SUSCEPTIBILITY OF WATER USING STANDARD BODIES Project Report, 1 Jun. 1970 - 30 Sep. 1971
Frank R. Schiebe Feb. 1972 74 p refs
(Contract N00014-67-A-0113-0020)
(AD-741698; Rept-118) Avail: NTIS CSCL 20/4

The report covers a feasibility study of the possibility of using the cavitation performance of standard bodies to measure the strength of water. An analytical cavitation model which utilizes a series of mathematically derived axisymmetric test bodies is combined with an acoustical cavitation occurrence counting instrumentation technique to establish an index which indicates the cavitation susceptibility of the test water in water tunnels. An equivalent size distribution of entrained microbubbles is proposed to represent the actual stream nuclei and to serve as the cavitation susceptibility index. GRA

N72-30302# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
ON THE SHOCK STAND-OFF DISTANCE IN AN INVISCID HYPERSONIC SOURCE FLOW PAST TWO DIMENSIONAL BLUFF BODIES
K. S. Nagaraja Dec. 1971 19 p refs
(AF Proj. 7064)
(AD-740566; ARL-71-0303) Avail: NTIS CSCL 20/4

The effect of high Mach number flows on test bodies can be estimated reasonably well by using the Newtonian approximation. If the flow is like a source flow then the effects of the ambient flow gradients on the flow parameters in the shock layer can be obtained by modifying the Newtonian formula. Freeman's theory is adopted in the present study and changes in surface pressure and shock detachment distance of a two-dimensional blunt body are obtained by using a perturbation scheme. Based on the ratio of the axial distance of a station on the body from the nose (which is of the coordinate frame) to the distance of the source location from the origin as a perturbation parameter, first order corrections to the surface pressure and the shock detachment distance are derived. Author

N72-30303# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE EFFECT OF POLYACRYLAMIDE ADDITIVES ON FRICTION RESISTANCE WITH A FLOW IN THE GAP BETWEEN COAXIAL CYLINDERS
Yu. F. Ivanyuta 6 Jan. 1972 11 p Tr. Leningr. Politekh. Inst. (Moscow), no. 313, 1970 p 123-127
(AF Proj. 7343)
(AD-740357; FTD-HT-23-1237-71) Avail: NTIS CSCL 20/4

Aqueous polyacrylamide (I) solutions had little effect on Reynolds number (RE) and on the transition from laminar to turbulent flow. The threshold RE or threshold friction decreased with increased molecular weight and concentration of I. The effectiveness of I additive to reduce the magnitude of the turbulent flow reached a maximum at a certain shear stress corresponding to a certain molecular weight and concentration. Any further increase in shear stress was accompanied by I degradation. Author (GRA)

N72-30872* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LIQUID-PROPELLANT DYNAMICS AND SUPPRESSION
David G. Stephens and Larry A. Kiefling *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 139-174 refs (For availability see N72-30865 21-31)
CSCL 20D

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N72-30304*# Colorado School of Mines, Golden.
GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Report for 30 Jun. - 31 Aug. 1972
Robert G. Reeves, Principal Investigator 7 Sep. 1972 3 p refs (Contract NAS5-21778)
(E72-10024; NASA-CR-127760) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-30305*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-A IMAGERY
Duwayne M. Anderson, Principal Investigator [1972] 4 p Proposed for presentation at 8th Intern. Symp. on Remote Sensing of the Environment, Ann Arbor, Mich., 2-6 Oct. 1972 Sponsored by NASA
(E72-10025; NASA-CR-127761) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-30306*# Purdue Univ., Lafayette, Ind.
A LAND USE CLASSIFICATION OF THE ERTS-A, COLLIN COUNTY, TEXAS, SUBFRAME OF THE TEXOMA FRAME
Marion F. Baumgardner, Principal Investigator 15 Sep. 1972 1 p Sponsored by NASA
(E72-10026; NASA-CR-127823) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-30307*# TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Aug. 1972
Donald J. Spencer, Principal Investigator 8 Aug. 1972 1 p (Contract NAS5-21746)
(E72-10027; NASA-CR-127892; TRW-7132.1-03) Avail: NTIS HC $3.00 CSCL 05B

There are no author-identified significant results in this report.

N72-30308*# Honeywell, Inc., St. Paul, Minn.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report
George Swanlund, Principal Investigator 31 Jul. 1972 3 p Sponsored by NASA
(E72-10028; NASA-CR-127893; PR-2) Avail: NTIS HC $3.00 CSCL 14E

There are no author-identified significant results in this report.

N72-30309*# North American Rockwell Corp., Thousand Oaks, Calif.
IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-A IMAGERY Progress Report, 30 May - 31 Jul. 1972
Monem Abdel-Gawad, Principal Investigator 31 Jul. 1972 1 p (Contract NAS5-21767)
(E72-10029; NASA-CR-127894; SC691.1PR) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-30310*# Wolf Research and Development Corp., Riverdale, Md.
THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA Progress Report
Allan Jelacic, Principal Investigator 4 Aug. 1972 2 p (Contract NAS5-21761)
(E72-10030; NASA-CR-127895) Avail: NTIS HC $3.00 CSCL 08L

There are no author-identified significant results in this report.

N72-30311*# National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Phase 1 Report, Jun. - Jul. 1972
Donald R. Wiesnet, Principal Investigator and David F. McGinnis Jul. 1972 4 p Sponsored by NASA
(E72-10031; NASA-CR-127896) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-30312*# Tri-State Regional Planning Commission, New York.
INVESTIGATION OF SATELLITE IMAGERY FOR REGIONAL PLANNING Progress Report
William Harting, Principal Investigator 12 Jul. 1972 1 p

Sponsored by NASA
(E72-10032; NASA-CR-127897; PR-1) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-30313*# Texas Technological Univ., Lubbock.
DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS
C. C. Reeves, Jr., Principal Investigator 18 Jul. 1972 4 p Sponsored by NASA
(E72-10033; NASA-CR-127898) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-30314*# Geological Survey, Menlo Park, Calif.
STUDIES OF INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-A Bimonthly Report
Erk Reimnitz, Principal Investigator and Peter Barnes 17 Jul. 1972 1 p Sponsored by NASA
(E72-10034; NASA-CR-127899) Avail: NTIS HC $3.00 CSCL 08J

There are no author-identified significant results in this report.

N72-30315*# Maryland Dept. of State Planning, Baltimore.
INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING IN MARYLAND Progress Report
Edwin L. Thomas, Principal Investigator 10 Aug. 1972 5 p Sponsored by NASA
(E72-10035; NASA-CR-127900; PR-1) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-30316*# Pittsburgh Univ., Pa. Space Research Coordination Center.
ANALYSIS OF OGO-6 OBSERVATIONS OF THE 0 I 5577A TROPICAL NIGHTGLOW
R. J. Thomas and T. M. Donahue Apr. 1972 24 p refs
(Contract NAS5-11077)
(NASA-CR-122456; SRCC-168) Avail: NTIS HC $3.25 CSCL 04A

Atomic oxygen green line data from the horizon scanning photometer on OGO-6 was examined. Unfolding the satellite data from the tropical F-region yields altitude and latitude variations of the O(1S) emissions. The spatial variations of the tropical F-region electron density are then calculated by assuming dissociative recombination and using a model atmosphere. Where comparisons to ground-based data are possible the results are good. Thus, the satellite observations constitute a form of topside sounding of the ionosphere below the F-peak and provide synoptic data about this portion of the ionsphere otherwise impractical to obtain. Author

N72-30317*# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
THE EXCITATION OF O2 IN AURORAS
David C. Cartwright, S. Trajmar, and W. Williams, Jr. 1 Mar. 1972 24 p refs Prepared in cooperation with JPL
(Contracts NAS7-100; F04701-71-C-0172)
(NASA-CR-127861; AD-738651; TR-0172(9260-01)-14) Avail: NTIS HC $3.25 CSCL 03B

Newly measured electron impact cross sections for excitation of the a 1 Delta g and b 1 Sigma g+ electronic states of O2 were employed to predict the absolute volume emission rates from these states under auroral conditions. A secondary electron zlectron flux typical of an IBC II nighttime aurora was used and the most important quenching processes were included in the calculations. The new excitation cross sections for the a 1 Delta g and b 1 Sigma g+ states are more than an order of magnitude larger than previous estimates, and lead to correspondingly greater intensities in the atmospheric and IR-atmospheric band systems. The calculated intensity ratios of the volume emission rates of 7621 A and 1.27 microns to that for 3914 A are smaller than obtained from aircraft observations and recent rocket experiments. Author

N72-30318*# California Univ., Riverside. Dept. of Geography.
MONITORING THE EVOLVING LAND USE PATTERNS USING REMOTE SENSING
Darryl R. Goehring Oct. 1971 110 p refs
(Grant NGL-05-003-404; Contract N00014-69-A-0200-5001; NR Proj. 387-047; Proj. Themis)
(NASA-CR-127834; T-71-5) Avail: NTIS HC $7.50 CSCL 13B

The urbanization of Walnut Valley from 1953-71 prompted land use change from intensive von Thunen market-oriented patterns to extensive, disinvested, production-factor-minimized patterns. Shortrun, interim land use planning, has allowed agriculture to persist but only in the form of barley farming and grazing. Aerial photography used synoptically recorded six periods of land use change that bracketed dates before and after the freeway was announced and built. Interpretations of these changes help recognize potential conversions to urban uses which allow guidelines to be established that deal with rural-urban transition problems before they arise. Author

N72-30319# Texas A&M Univ., College Station.
PROCEEDINGS OF THE SYMPOSIUM ON REMOTE SENSING IN MARINE BIOLOGY AND FISHERY RESOURCES
Mar. 1971 305 p refs Symp. held at College Station, Tex. Sponsored by the Food and Agr. Org. and Intergovernmental Oceanog. Comm. and NSF
(TAMU-SG-71-106) Avail: NTIS; Office of Sea Grant Program, Texas A&M Univ., College Station, Tex. 77843: $4.00

The objectives of this conference were two-fold: (1) to bring together the investigators active in the utilization of remote sensing in marine biology and fisheries; and (2) to provide for discussions leading to improved harvest and management of these resources. For individual titles, see N72-30320 through N72-30335.

N72-30320 National Marine Fisheries Service, Bay Saint Louis, Miss.
REMOTE SENSING IN THE NATIONAL MARINE FISHERIES SERVICE
W. H. Stevenson *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 1-7 (For availability see N72-30319 21-13)

The NMFS seeks to discover, describe, develop, and conserve the living resources of the global sea, especially as these affect the American economy and diet. The objective of the program is recruit new tools to locate, survey, and monitor living marine resources, and to facilitate the incorporation of these tools into ongoing survey and harvesting procedures. The tools under consideration are spectrophotometers, low light level image intensifiers, lasers, acoustic imaging, micro-infrared detectors, and photography. The remote sensing program is organized into three components: management, evaluation, and operations. The duties and responsibilities of these three groups are briefly described. A.L.

N72-30321 Earth Satellite Corp., Washington, D.C.
OPERATIONAL USE OF REMOTE SENSORS IN COMMERCIAL FISHING
Paul M. Maughan and Allan D. Marmelstein *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 8-24 refs (For availability see N72-30319 21-13)

The history of the development of aerial fish spotting is reviewed and some examples of its use in commercial fishing operations such as catching menhaden are described. The future use of remote sensors in resource management is considered. Briefly discussed is a system incorporating a low light level sensor, a Doppler laser, and a computer for harvesting menhaden at night. A.L.

N72-30322 Ocean Protein, Inc., Lafayette, La. Zapata Remote Sensing Div.
SOME POTENTIAL APPLICATIONS OF REMOTE SENSING IN FISHERIES
Kirby L. Drennan *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 25-65 refs Sponsored by Naval Oceanographic Office (For availability see N72-30319 21-13)

Present techniques utilized by industry and Government to locate harvestable fish stocks and survey the resources of large oceanic areas, are inadequate. Remote sensing from aerospace platforms appears to offer a more effective and economical means for assessing present resources and providing the information needed to predict the future abundance and distribution of fishery resources. A number of significant characteristics of fish and their environment, which may be observed through the use of remote sensors, are presented. Those sensors which have been shown to have potential application as well as the environmental factors which contribute to and limit their usefulness, are also discussed. Author

N72-30323 Woods Hole Oceanographic Institution, Mass.
REMOTE SPECTROGRAPHY OF OCEAN COLOR AS AN INDEX OF BIOLOGICAL ACTIVITY
Gifford C. Ewing *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 66-74 refs (For availability see N72-30319 21-13)

Over 3,000 ocean spectra of sunlight backscattered from the upper layers of the sea have been obtained at flight altitudes to 10,000 feet together with detailed ground truth. The backscattered light in each part of the visible spectrum has been calculated as a percentage of the incident downwelling irradiance at the sea surface. The spectrum thus obtained reveals the action of the water itself and of materials suspended and dissolved in the water. The relationship between light extinction and biological productivity has been studied. Certain important materials have recognizable spectral signatures; thus the shape of the spectrum can be used to measure the kinds and amounts of substances present. Although the shape of the spectra changed characteristically with altitudes, the differences between members of each pair and their contrast ratio remained nearly the same and clearly showed the location of the transition.
Author

N72-30324 Massachusetts Univ., Gloucester.
THE ABSORPTION AND FLUORESCENCE CHARACTERISTICS OF BIOCHEMICAL SUBSTANCES IN NATURAL WATERS
Charles S. Yentsch *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 75-97 ref (For availability see N72-30319 21-13) (Contract AT(30-1)-4241; Grant NSF GA-27082)

The major factors known to selectively transmit or remove wavelengths of visible light in ocean water are reviewed. The prime substances affecting light absorption and fluorescence and what environmental factors alter their distribution and abundance are discussed. Problems where remote sensing would be invaluable are suggested. Author

N72-30325 Barringer Research Ltd., Rexdale (Ontario).
THE REMOTE SENSING OF VAPORS OF MARINE ORGANIC ORIGIN
A. J. Moffat and A. R. Barringer *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 98-126 refs (For availability see N72-30319 21-13)

Three types of remote sensing of vapors are possible, one of which is suitable for use from high altitude aircraft and spacecraft and the other two from low altitude aircraft and ships. In the case of high altitude remote sensing, optical methods can be employed in vertical incidence for detecting spectral characteristics of emitted or reflected optical radiation. Experiments have been carried out with a technique known as correlation spectroscopy in which incoming radiation in the visible spectrum has been matched in real time against a stored replica of the iodine spectrum in order to monitor the vertical burden of free iodine over the ocean. Iodine is considered to be of interest as a potential indicator of biological productivity and region of primary fish food. Greater sensitivity can be achieved, however, with these techniques used in horizontal scanning modes from low flying aircraft, ships and truck-mounted monitors on the coastline. There has been some evidence that increased concentrations of free iodine vapor can be measured over plankton areas using the latter technique. Theoretical calculations indicate that instruments can be optimized for iodine detection to provide adequate sensitivity for satellite monitoring. Author

N72-30326 Baird-Atomic, Inc., Bedford, Mass.
REMOTE SENSING OF MARINE AND FISHERIES RESOURCES BY FLOURESCENCE METHODS
A. W. Hornig *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 127-157 Sponsored by Naval Oceanographic Office (For availability see N72-30319 21-13)

Many materials of importance to marine and fisheries resources fluoresce with sufficient efficiency to be detectable at reasonable aircraft altitudes when excited at night with existing light sources. Further, the specificity of the excitation and emission spectra is great enough to allow discrimination between many materials. Arc or laser stimulated fluorescence promises to provide a new and useful method for remote sensing which supplements multispectral and color photography. Author

N72-30327 Oregon State Univ., Corvallis. Dept. of Oceanography.
REMOTE SENSING AND THE PELAGIC FISHERIES ENVIRONMENT OFF OREGON
William G. Pearcy *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 158-171 refs (For availability see N72-30319 21-13) (Contract N622306-70-C-0414; NSF GH-45)

These investigations were undertaken during 1969 and 1970 to: (1) learn more about the ocean conditions off Oregon during the summer and how they effect the albacore tuna catches and the productivity of the pelagic food chain; and (2) provide albacore fishermen with information in near real time that could be used in scouting for fish. The research constituted a broad and multidisciplinary program, and included four interdependent components: (1) remote sensing aircraft; (2) oceanographic vessels; (3) commercial albacore boats; and (4) albacore advisory service. Remote sensing aircraft used infrared radiometers, multispectral scanners, ocean color spectrometer, L-band microwave radiometer, and multispectral photography. Results to date are all preliminary. The catch data from both 1969 and 1970 are still being processed. The data obtained from the multispectral scanner, the spectrometer, and microwave are on tape and are being analyzed. Author

N72-30328 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MAN'S EFFECTS ON THE ESTUARINE ENVIRONMENT
Leo F. Childs *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 172 (For availability see N72-30319 21-13)

Color slides taken over a number of years were used to illustrate the effects of industrialization and the encroachment of over population on the estuarine environment in the Gulf of

Mexico. Photography from the Gemini, Apollo, and aircraft program were included. Author

N72-30329 General Aniline and Film Corp., Binghamton, N.Y.
GAF COLOR FILMS FOR SPECIAL REMOTE SENSING APPLICATIONS c14
Ira B. Current *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 173-193 refs (For availability see N72-30319 21-13)

Three types of GAF color aerial film are described and the conditions under which each is best suited for use in photographing beneath water surfaces are discussed. The types considered are: GAF 200 and 500 color aerial film, and GAF 1000 blue insensitive color aerial film. A.L.

N72-30330 Michigan Univ., Ann Arbor.
APPLICATIONS OF MULTISPECTRAL SENSING TO MARINE RESOURCES SURVEYS
Fabian C. Polcyn *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 194-217 refs (For availability see N72-30319 21-13)

Applications of the multispectral scanner technique to various aspects of the marine environment are described. Covered are: (1) mapping of aquatic vegetation; (2) the feasibility of remotely measuring water depth; (3) the study of thermal effluents and associated water mass movements; (4) the detection of industrial discharges; and (5) the mapping of large oil slicks near shore while differentiating the oil from some of the aquatic vegetation such as kelp that occurs in certain areas. Author

N72-30331 Institute of Marine Research, Bergen (Norway).
ACOUSTIC METHODS FOR ESTIMATION OF FISH ABUNDANCE
Lars Midttun *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 218-226 (For availability see N72-30319 21-13)

A simple description is given of a system now in use on board several research vessels in Europe and at many FAO projects for estimating fish abundance. The system consists of: (1) an echo sounder calibrated for source level, receiving sensitivity, and beam form; (2) an oscilloscope for reading the signal strength of reflected echoes; and (3) an integrator with two or more channels and paper recorders for each channel. The use of this equipment, and the problems involved, in measuring fish populations is disussed. A.L.

N72-30332 Virginia Univ., Charlottesville.
STUDIES OF BENTHIC COVER IN NEAR SHORE TEMPERATE WATERS USING AERIAL PHOTOGRAPHY
Mahlon G. Kelly *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 227-248 refs (For availability see N72-30319 21-13)
(Contract N62306-70-A-0073-0003)
(Tr-0006)

This research was undertaken to: (1) determine the feasibility of using aerial photography to study the distribution of benthic cover in turbid Long Island; (2) to find the best type of photography for that purpose; (3) to describe and map as much of the benthic cover as possible; (4) to examine what may be deduced from the patterns of distribution; and (5) to compare these patterns with those previously studied in the much clearer waters of South Florida. The ultimate goal is to obtain a better understanding of factors determining the distributional patterns of shallow benthic cover. The films, cameras, altitudes flown, and results are described in detail. Author

N72-30333 Intergovernmental Oceanographic Commission, Paris (France).
AN APPLICATION OF THE THEORY OF GAMES TOWARD IMPROVING THE EFFICIENCY OF CERTAIN PELAGIC FISHING OPERATIONS
Saul B. Saila *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 249-265 refs (For availability see N72-30319 21-13)

The problem of how a fishing vessel should allocate search effort in order to make the probability of encounter and capture of a fish shoal as high as possible under specific conditions is briefly considered. The rational allocation of available search time as suggested in this report involved no additional expense for equipment. It merely involves some relatively simple calculations. Tentative conclusions include: (1) The fishing vessel must be relatively close to the coordinates of the initial sighting in order to make the probability of success high enough to justify search effort. (2) Any additional information on the direction and/or velocity of the fish shoal reduces the difficulty of the search problem and increases the probability of success greatly. (3) If the remote sensing device can only report position coordinates, then further behavioral and other biological information is clearly needed. Author

N72-30334 Texas A&M Univ., College Station. Dept. of Veterinary Microbiology.
THE USE OF FISH IN BIOLOGICAL SITUATIONS
George W. Klontz *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 266-270 refs (For availability see N72-30319 21-13)

Some of the problems involved with the increased use of fish in biological research projects are reviewed. These include: (1) proper selection of experimental fish in terms of object of research; (2) maintenance of as near optimum environmental conditions as possible; (3) selection of size and shape of containers; (4) rigid sanitation practices; and (5) proper feed and nutrition. A.L.

N72-30335 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UPWELLING STUDIES WITH SATELLITES
Karl-Heinz Szekielda *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 271-293 refs (For availability see N72-30319 21-13)

Two different ways of obtaining surface temperature structures with data from an orbiting platform are: (1) Analysis of radiometric recordings during one overpass over apparently cloud-free regions has provided the surface structures of an area. This method can be used to analyze a synoptic recording and has the further advantage of noting rapid changes in the sea surface temperatures over typical scales of a few days. (2) Mapping the sea surface temperature through use of a multispectral method which detects cloud-free conditions and uses the radiation for the determination of the sea surface temperature. This method includes data recorded from orbiting platforms over a period of 2 to 4 weeks; therefore, short-time fluctuations are smoothed out. The method is applicable to map ocean surfaces on a global scale. Both methods were used to study areas in oceans where upwelling exists. Author

N72-30336*# Scripta Technica, Inc., Washington, D.C.
PROPAGATION OF VISIBLE AND INFRARED WAVES IN THE ATMOSPHERE
V. Ye. Zuyev NASA Jul. 1972 429 p refs Transl. into ENGLISH of the publ. "Rasprostraneniye Vidimykh i Infrakrasnykh Voln v Atmosfere" Moscow, Sov. Radio Pres), 1970
(Contract NASw-2036)
(NASA-TT-F-707) Avail: NTIS HC $6.00 CSCL 20N

The basic results are reported of theoretical and experimental investigations of various aspects of the problem of propagation of visible and infrared waves in the atmosphere. The generalization is based on the research of the author and his colleagues and on other studies carried out both in the USSR and abroad. Problems of the absorption and scattering of both monochromatic and nonmonochromatic radiation under various meteorological conditions, over various distances, and in various directions of propagation are examined. Descriptions are presented of the propagation behavior of spatially limited beams of radiation from

thermal sources and lasers in the atmosphere: the structure of the beam in various scattering media, the influence of atmospheric turbulence on beam parameters, and nonlinear effects that accompany the propagation of highenergy radiation in the atmosphere. The book is designed for a broad range of readers working in the fields of atmospheric optics and spectroscopy, meteorology, geophysics, geodesy and astrophysics, and opticoelectronic and laser engineering, as well as for senior students in the corresponding specialties. Author

N72-30337*# Translation Consultants, Ltd., Arlington, Va.
THE TEMPERATURE OF IRRIGATED SOIL
J. Pletser Washington NASA Aug. 1972 4 p refs Transl. into ENGLISH from Idojaras (Budapest), v. 64, no. 2, Mar. - Apr. 1960 p 113-114
(Contract NASw-2038)
(NASA-TT-F-14500) Avail: NTIS HC $3.00 CSCL 08M

The results of experiments to determine the effect of irrigation on soil temperature are discussed. Author

N72-30338*# Translation Consultants, Ltd., Arlington, Va.
METHOD FOR DETERMINATION OF THE HEAT FLUX IN SOIL AND ITS APPLICATION TO FIELD MEASUREMENTS
E. T. Kiss Washington NASA Aug. 1972 10 p refs Transl. into ENGLISH from Idojaras (Budapest), v. 64, no. 6, 1960 p 365-371
(Contract NASw-2038)
(NASA-TT-F-14501) Avail: NTIS HC $3.00 CSCL 08M

The surface energy balance is discussed briefly and is followed by an analysis of the thermal and physical characteristics of the soil. Tseytin's method for determining the heat flux in the soil is discussed in detail and the method is applied to data from measurements made at Lake Balaton in 1959. The results are compared with data for other heat balance factors. Author

N72-30339*# Translation Consultants, Ltd., Arlington, Va.
TEMPERATURE OF GRASSY AND ROLLED SOILS
Z. H. Varga Washington NASA Aug. 1972 5 p refs Transl. into ENGLISH from Idojaras (Budapest), v. 67, no. 3, May - Jun. 1963 p 178-179
(Contract NASw-2038)
(NASA-TT-F-14512) Avail: NTIS HC $3.00 CSCL 08M

A method is described for determining if there is any significant difference between grassy soil and cultivated soil temperatures, primarily for agricultural meteorological stations. Measurements in a layer 2 to 5 cm deep were taken over a 24-hour period and were divided into a day period during which the heat flux was directed into the soil and the night during which the heat was emanating from the surface. The temperature of the grassy soil was found to be significantly cooler at noon than the temperature of rolled or cultivated soils. There is no significant difference between the night temperatures. Author

N72-30340# Moss Landing Marine Labs., Calif.
AIR FLOW LAND-SEA-AIR INTERFACE MONTEREY BAY, CALIFORNIA, 1971 Annual Report
Robert G. Read Jul. 1972 28 p refs
(Grant CD-2-35137)
(CASUC-MLML-TP-72-04-Pt-1; Contrib-29) Avail: NTIS HC $3.50

Air flow at the land-sea-air interface influences to a large extent the atmospheric conditions that determine the transport, dilution, and trapping of natural and man-made air pollutants in the coastal areas of Monterey Bay and the Salinas Valley. Analysis of the hourly air flow on a daily and monthly basis indicates patterns of stagnation from midnight to noon of the following day with moderate to strong air flow during period 1300 to 2200. Throughout the year 1971 whenever flow is greater than 5 mph, the prevailing wind direction is onshore and from a westerly direction. Suggestions for urbanization and industrialization are made on the basis of an understanding of the atmospheric conditions which lead to trapping and dispersal of atmospheric waste. Author

N72-30341# Pennsylvania State Univ., University Park. Ionospheric Research Lab.
THE Hg (1P1) SENSITIZED PHOTOLYSIS OF N2 AND CO
R. Simonaitis and Julian Heicklen 23 Jun. 1972 36 p refs
(Grant NSF GA-12385)
(PSU-IRL-SCI-394) Avail: NTIS HC $4.00

The Hg(1P1) sensitized photolysis of CO and CO - O2, CO - N2, N2 - CO2 - NO, and N2 - N2O - NO mixtures were studied at 25 C. Hg (1P1) sensitization of CO leads to small amounts of CO2 and C3O2, and this is taken as evidence for some CO(a(3)pi) production. The CO2 quantum yield increases markedly in the presence of O2, but the enhancement can be explained entirely by the oxidation of vibrationally excited CO. The Hg(1P1) sensitization of N2 can proceed by three paths. Author

N72-30342*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMPROVEMENT OF SYNOPTIC SCALE MOISTURE AND WIND FIELD ANALYSES USING THE NIMBUS 4 THIR 6.7 MICRON OBSERVATIONS
Joseph Steranko, Lewis J. Allison, and Vincent V. Salomonson Apr. 1972 30 p refs
(NASA-TM-X-65996; X-651-72-101) Avail: NTIS HC $3.50 CSCL 03B

The Nimbus 4 temperature-humidity infrared radiometer (THIR) monitors radiation in the 6.5 to 7.2 micron water vapor absorption with a 23 kilometer spatial resolution at the sub-satellite point. Radiation monitored in this spectral region results primarily from emission in the 250 to 500 millibar region of the upper troposphere. The THIR 6.7 micron observations are readily available in photofacsimile imagery form which shows very distinctive patterns associated with spatial variations in atmospheric water vapor. These radiometric observations were combined in several instances with moisture values measured in the upper troposphere by the standard radiosonde network. In each instance, the result is a much more consistent analysis showing increased spatial detail that agrees with the radiometric observations and does not compromise the conventional data. The improved moisture analyses show relatively dry and moist tongues that are very difficult or impossible to infer from the conventional data alone. The patterns in the moisture fields can be tracked over 12 and 24 hour periods. In addition, by keeping in mind the advective properties of the moisture field, success was achieved in improving streamline analyses at the 400 mb level over data sparse regions on a global scale. Author

N72-30343*# Massachusetts Inst. of Tech., Cambridge.
METEOROLOGICAL AND ECOLOGICAL MONITORING OF THE STRATOSPHERE AND MESOSPHERE
Reginald E. Newell and Carlton R. Gray Washington NASA Aug. 1972 166 p refs
(Contract NAS1-9884)
(NASA-CR-2094; AER-12-F) Avail: NTIS HC $3.00 CSCL 04A

A concept for determining the constituent densities of ozone, atomic oxygen, aerosols, and neutral density in the 20 to 1000 km region of the atmosphere from a satellite was developed. The concept includes the daytime measurement of solar scattering at the earth's limb in selected narrow spectral bands of the ultraviolet and visible regions, and the measurement of selected (dayglow) emissions. Nighttime measurements of the atmospheric extinction of stellar energy in selected bands are also considered as are simultaneous measurements of the 5577 airglow and molecular oxygen emission in the Herzberg band. Radiative-transfer models and recursive inversion algorithms are developed for the measurements, and the accuracy of the concept is assessed. Author

N72-30344*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CONCEPTS AND PROCEDURES USED TO DETERMINE CERTAIN SEA WAVE CHARACTERISTICS
Allen D. Cummings, Arthur M. Whitnah, David B. Howes, and B. J. Wells (LTV/STC) Washington Sep. 1972 27 p refs

(NASA-TN-D-6961; S-245) Avail: NTIS HC $3.00 CSCL 08C

A technique and its application are presented by which wave parameters, critical to spacecraft water impact load analysis, may be determined. Author

N72-30345*# Michigan Univ., Ann Arbor. Infrared and Optics Lab.

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION, FIRST SUPPLEMENT

V. Leeman [1972] 159 p refs

(Contract NAS9-9784)

(NASA-CR-115756; WRL-31650-69-T-Suppl-1) Avail: NTIS HC $10.00 CSCL 08G

The NASA Earth Resources Spectral Information System and the information contained therein are described. It is intended to be used as a supplement to the NASA Earth Resources Spectral Information System: A Data Compilation, N72-28366. This supplement includes approximately 500 rock and mineral, 100 soil, and 30 vegetation bidirectional and directional reflectance, transmittance, emittance, and degree-of-polarization curves in the optical region from 0.2 to 22.0 microns. The data have been categorized by subject and each curve plotted on a single graph. For some rocks and minerals, all curves of the same type, differing only in particle size, have been plotted on one grid as a composite plot. Each graph, composite or single, is fully titled to indicate curve source and is indexed by subject to facilitate user retrieval. Author

N72-30346*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TROPOSPHERIC RANGE ERROR PARAMETERS: FURTHER STUDIES

H. S. Hopfield Aug. 1972 48 p refs

(NASA-TM-X-66002; X-551-72-285) Avail: NTIS HC $4.50 CSCL 03B

Improved parameters are presented for predicting the tropospheric effect on electromagnetic range measurements from surface meteorological data. More geographic locations have been added to the earlier list. Parameters are given for computing the dry component of the zenith radio range effect from surface pressure alone with an rms error of 1 to 2 mm, or the total range effect from the dry and wet components of the surface refractivity and a two-part quartic profile model. The new parameters are obtained, as before, from meteorological balloon data but with improved procedures, including the conversion of the geopotential heights of the balloon data to actual or geometric heights before using the data. The revised values of the parameter k (dry component of vertical radio range effect per unit pressure at the surface) show more latitude variation than is accounted for by the variation of g, the acceleration of gravity. Author

N72-30347*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AVERAGE DAILY VARIATIONS IN THE MAGNETIC FIELD AS OBSERVED BY ATS-5

T. L. Skillman Aug. 1972 55 p refs

(NASA-TM-X-66004; X-645-72-301) Avail: NTIS HC $4.75 CSCL 03B

Hourly averages of the magnetic field components are determined and analyzed using the measurements, by the magnetic field monitor (MFM) aboard the ATS-5 satellite. The data covering the time period of September 1969 through September 1971 are sorted and analyzed for various Kp values, geomagnetic latitude of the subsolar point, and local time. Local time variations are harmonically analyzed, and amplitudes and phases are given up to the fourth harmonic. Author

N72-30348# Lockheed Missiles and Space Co., Palo Alto, Calif.

DETERMINATION OF THE ELECTRON COLLISION FREQUENCY IN THE E REGION OF THE IONOSPHERE FROM ROCKET AND GROUND BASED MEASUREMENT DATA DURING FLIGHT OF THE VERTIKAL-1 ROCKET

K. Bischoff, K. N. Gringauz, G. Klein, I. A. Knorin, G. Kober, and V. A. Rudakov [1972] 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 10, no. 2, 1972 p 228-238

Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Experimental determinations of electron collision frequencies in the E layer of the ionosphere are obtained by evaluating simultaneous ground based radio frequency absorption measurements and rocket-borne radio interferometer observations. Results show that at least for low angles of observation of the sun at sunrise, the main part of the absorption drops into the region near the reflection altitude so that radiowaves with 1.5 and 2.0 MHz frequencies are absorbed considerably in the lower part of the E region. The vertical electron concentration profile depends on the local time, the season, and the level of solar activity. G.G.

N72-30349*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROWAVE SIGNATURES OF FIRST-YEAR AND MULTIYEAR SEA ICE

P. Gloersen, P. Nordberg, T. J. Schmugge, T. T. Wilheit, and W. J. Campbell (Geological Survey) Aug. 1972 22 p refs Submitted for publication Original contains color illustrations

(NASA-TM-X-66006; X-652-72-312) Avail: NTIS HC $3.25 CSCL 08L

A combination of remote sensing from an aircraft and simultaneous surface measurements have confirmed the feasibility of identifying old and new sea ice according to its emission of thermal radiation at wavelengths between 0.3 and 3 cm. Emissivity of first-year thick ice with a surface temperature of about 260 K is 0.95 or greater for wavelengths between 0.81 and 11 cm; the emissivity of multiyear ice is 0.8 at 0.81 cm and 0.95 at 11 cm, increasing monotonically in this wave length interval. The ease with which multiyear ice can be distinguished from first-year ice using a passive microwave radiometer is demonstrated by comparing mosaics prepared both from photographs and images of 1.55 cm radiation. Author

N72-30350# Coastal Plains Center for Marine Development Services, Wilmington, N.C.

AN ENVIRONMENTAL INVENTORY FOR THE COASTAL PLAIN AND ADJACENT ATLANTIC WATERS OF THE SOUTHEASTERN STATES. PART 3: AN INDEX TO HYDROGRAPHIC SURVEYS FOR COASTAL AND INSHORE WATERS OF THE CAROLINAS AND GEORGIA

1972 75 p

(Publ-72-6-Pt-3) Avail: NTIS HC $5.75

A single source index of the hydrographic data collected for the coastal and inshore waters of the southeastern states is presented. The data is presented in the form of maps and show the surveys conducted during the period 1847 to 1969. The maps and charts are compiled an updated using aerial photographs and field surveys as a basis. Author

N72-30351# National Oceanic and Atmospheric Administration, Boulder, Colo. Aeronomy Lab.

IONOSPHERIC DRIFT VELOCITY MEASUREMENTS AT JICAMARCA, PERU (JULY 1967 - MARCH 1970)

Ben B. Balsley and Ronald F. Woodman (Inst. Geofis. del Peru, Lima) Asheville, N. C. Oct. 1971 45 p refs

(UAG-17) Avail: SOD $0.35 as C55.220:17

Measurements of electron drift velocity in the E and F regions of the equatorial ionosphere, made the the Jicamarca radar observatory, are reported. The data consist of about eighty days of observations during the period July 1967 and March 1970. The measurements consist of: (1) The vertical component of the electron drift velocity in the F region; and (2) the east-west component of the electron drift velocity in the E region. The horizontal component (H trace) of the magnetic field strength records of Huancayo, Peru, has also been included for reference. Author

N72-30352# National Environmental Satellite Center, Washington, D.C.
TEMPERATURE SOUNDING FROM SATELLITES
S. Fritz, D. Q. Wark, H. E. Fleming, W. L. Smith, H. Jacobowitz, D. T. Hilleary, and J. C. Alishouse Jul. 1972 53 p refs
(NOAA-TR-NESS-59) Avail: SOD $0.55

Vertical temperature sounding of the atmosphere can be calculated from satellite radiance measurements. The theory relating satellite radiance measurements to temperatures in the atmosphere for both cloudless and cloudy conditions is presented. The accuracy of vertical temperature soundings from satellites in comparision with radiosonde measurements is judged on the basis of two years of operational experience. The RMS temperature errors varied from 1.1 K to 3 K for clear conditions, and from 1.6 K to 3.5 K for conditions during which high clouds were judged to be present. Sounding instruments already flown on Nimbus satellites and instruments to be flown in the near future are reviewed. Remaining problems which require further work to improve the accuracy of remote vertical temperature soundings are discussed. Author

N72-30353*# Massachusetts Inst. of Tech., Cambridge. School of Engineering.
FINITE ELEMENT ANALYSIS OF ELASTO-PLASTIC SOILS. REPORT NO. 4: FINITE ELEMENT ANALYSIS OF ELASTO-PLASTIC FRICTIONAL MATERIALS FOR APPLICATION TO LUNAR EARTH SCIENCES
W. Allen Marr, Jr. Jun. 1972 103 p refs
(Contract NAS9-9990)
(NASA-CR-128529; Soils-Publ-301; R72-21) Avail: NTIS HC $7.25 CSCL 08M

The behavior of finite element models employing different constitutive relations to describe the stress-strain behavior of soils is investigated. Three models, which assume small strain theory is applicable, include a nondilatant, a dilatant and a strain hardening constitutive relation. Two models are formulated using large strain theory and include a hyperbolic and a Tresca elastic perfectly plastic constitutive relation. These finite element models are used to analyze retaining walls and footings. Methods of improving the finite element solutions are investigated. For nonlinear problems better solutions can be obtained by using smaller load increment sizes and more iterations per load increment than by increasing the number of elements. Suitable methods of treating tension stresses and stresses which exceed the yield criteria are discussed. Author

N72-30354*# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
THE IR EMISSION SPECTRUM OF N2 EXCITED UNDER AURORAL CONDITIONS
David C. Cartwright, Walter Williams, and Sandor Trajmar 1 Mar. 1972 18 p refs Prepared in cooperation with JPL
(Contracts NAS7-100; F04701-71-C-0172)
(NASA-CR-128025; SAMSO-TR-72-51; AD-738652; TR-0172(9260-01)-15) Avail: NTIS HC $3.00 CSCL 04A

Recently determined experimental and theoretical cross sections for electron impact excitation of six triplet states of N2 (A, B, W, C, E, D) have been utilized to predict the absolute IR volume emission rates from N2 under night time auroral conditions. Secondary electron fluxes appropriate to an IBC 2 normal aurora were used in the calculations. The cascade contributions coupling the various electronic states were included as well as the most important quenching processes. The results indicated that the cascade processes, which are important in the population of the A, B, and W states, produce appreciable radiation in the 1 - 5 micron wavelength region. Author

N72-30355*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VERTICAL RESOLUTION OF TEMPERATURE PROFILES OBTAINED FROM REMOTE RADIATION MEASUREMENTS
Barney J. Conrath Nov. 1971 31 p refs
(NASA-TM-X-66009; X-622-71-51) Avail: NTIS HC $3.75 CSCL 04A

The Backus-Gilbert theory, originally developed for analysis of inversion problems associated with the physics of the solid earth, was applied to the problem of the vertical sounding of the atmosphere by means of remote radiation measurements. An application was made to spectral intervals 2.8/cm wide in the 667/cm band CO2, and tradeoff curves are presented which quantitatively define the relationship between intrinsic vertical resolution and random error in temperature profile estimates. It is found that for a 1-2 K random error with state-of-the-art instrumentation, the intrinsic vertical resolution ranges from approximately 0.5 locale scale height (l.s.h.) in the lower troposphere to greater than 2 l.s.h. in the upper stratosphere with approximately 1 l.s.h. resolution in the vicinity of the tropopause. These values are somewhat smaller than the widths of the radioactive transfer kernels at similar levels. Increasing the number of spectral intervals from 7 to 16 is found to produce only a marginal improvement in vertical resolution. Author

N72-30356# Committee on Commerce (U. S. Senate).
INTERNATIONAL CONFERENCE ON OCEAN POLLUTION
Washington GPO 1972 129 p Hearings before Comm. on Com., 92d Congr., 2d Sess., 18 Oct. and 8 Nov. 1971
Avail: Subcomm. on Oceans and Atmosphere

Hearings on ocean pollution held before the Senate Subcommittee on Oceans and Atmosphere are presented. The witnesses include Scott Carpenter, Captain Jacques Cousteau, Christian A. Herter, Jr., Mark Morton, Dr. Barry Commoner, Hugh Downs, and Dr. Thor Heyerdahl. A paper by Dr. Commoner on the origins of the environmental crisis is also included. N.E.N.

N72-30357# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.
ENVIRONMENTAL RADIATION SURVEYS AND SNOW MASS PREDICTIONS FROM AIRCRAFT
L. J. Deal (AEC, Washington, D. C.), J. F. Doyle, Z. G. Burson, and A. E. Fritzsche 25 Jun. 1971 23 p Presented at 7th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 17-21 May 1971 Sponsored by AEC
(EGG-1183-1522; Conf-710540-1; L-1034) Avail: NTIS

An aerial radiation detection and tracking system is described and its use in recording radiation levels from isotopes in air, on the ground, or in the soil is discussed. Information is included on instrumentation and radioisotope detectability. Experiments and field tests are described to illustrate the capabilities of the system. NSA

N72-30358# Istituto di Fisica Dell Atmosfera, Rome (Italy).
CONSIDERATIONS ON CHARACTERISTIC PERIODS OF ADRIATIC SEA LEVEL OSCILLATIONS [CONSIDERAZIONI SUI PERIODI CARATTERISTICI DELLE OXCILLAZIONI DEL LIVELLO MARINO IN ADRIATICO]
S. Palmieri and C. Finizio Dec. 1970 19 p refs In ITALIAN; ENGLISH summary Sponsored by Min. dei Lavori Pubblici Prepared jointly with Aeron. Mil. Ital.
(IFA-STR-16) Avail: NTIS HC $3.00

The characteristic periods of the Adriatic sea basin were determined using an existing numerical model. Results are compared with those obtained by analysis of the sea-level time series. The differences can be explained by taking into account the duration of the wind impulses responsible for the sea level oscillation. ESRO

N72-30359# Danish Meteorological Inst., Charlottenlund.
ELECTRIC FIELDS AND HIGH-LATITUDE ZONAL CURRENTS INDUCED BY MERGING OF FIELD LINES
J. Wilhjelm and E. Friis-Christensen 1972 21 p refs Submitted for publication
(DMI-Geophys-Papers-R-31) Avail: NTIS HC $3.25

Zonal ionospheric currents flowing along segments of approximately equal geomagnetic invariant latitude are demonstrated to exist near the day-side polar cusp region

superimposed upon the double vortex current system. The zonal currents are caused by an electric field, which is induced into the magnetosphere by merging of field lines. The electric field is transmitted to the ionosphere along the equipotentials of the polar cusp field lines, which are connected to the interplanetary magnetic field lines. The reconnection model is in agreement with the I 5 measurements of the magnetospheric electric field and give substantial support to a recently proposed model of the magnetosphere. Various implications of the model are discussed.
Author (ESRO)

N72-30360# Danish Meteorological Inst., Charlottenlund.
THE INFLUENCE OF THE DIRECTION OF THE INTERPLANETARY MAGNETIC FIELD ON THE MORPHOLOGY OF GEOMAGNETIC VARIATIONS AT HIGH MAGNETIC LATITUDE
E. Friis-Christensen 1971 156 p refs
(DMI-Geophys-Papers-R-27) Avail: NTIS HC $10.00

The diurnal variations of the magnetic field at the polar cap observatories of Godhavn and Thule which are influenced by the interplanetary magnetic field are studied. The influence of global magnetic activity is found to affect the horizontal component H at Godhavn but not the vertical component Z at Thule. A difference in the daily mean values of H and Z provide a method for determining the sector structure of the interplanetary magnetic field.
ESRO

N72-30361# Interuniversitair Reactor Instituut, Delft (Netherlands).
MERCURY DISTRIBUTION LEVELS OBSERVED IN VARIOUS ECOSYSTEMS AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS
J. J. M. DeGoey, J. P. W. Houtman, P. S. Tjioe, and J. H. Koeman (Inst. for Vet. Pharmacol. and Toxicol.) 1972 20 p refs
(IRI-133-72-04) Avail: NTIS HC $3.00

An automated instrument was devised for measurement of mercury concentration above 0.1 ppb in 90 samples per week. Some information is provided about the transport of mercury from soil (river sludge) via grass to cattle; about the behavior of mercury in the ecosystems water, molluscs, eiderduck, fish, sandwich tern, and seal; and about the uptake of mercury from organic seed dressings (through mice) by predatory birds. Mercury contents of various canned fish samples for human consumption are given.

N72-30362# European Space Research Inst., Frascati (Italy).
INCREASE OF Na TWILIGHT EMISSION AFTER THE EARTH'S CROSSING OF COMETS HALLEY AND ENCKE ORBITAL PLANES
G. Visconti (Aquila Univ., Italy) and G. Fiocco 1972 8 p refs
Avail: NTIS HC $3.00

Measurements of the Na twilight emission in the upper atmosphere, taken on three different occasions, around the time of the crossing of the orbital plane of the Halley (1971, 1972) and Encke (1971) comets, show an enchancement two or three days after the crossing. Data support the hypothesis that dust particles of cometary origin enter the atmosphere and fragment into small grains, and that Na is produced by sublimation from the grains.
ESRO

N72-30363# Royal Aircraft Establishment, Farnborough (England).
AN ASSESSMENT OF THE SEA-STATE MEASUREMENT PROBLEM AT RAE ABERPORTH
J. W. Cooper and T. G. Wills Oct. 1971 27 p ref
(RAE-TR-71207; BR27442) Avail: NTIS HC $3.50

The general requirements for sea state measurement at RAE Aberporth is established and followed by detailed consideration of the parameters by which it may be described. Parameters under consideration are: tide height, wave height, wave direction, wind speed and direction, vertical wind, air temperature, sea surface temperature, and sub-surface temperature. Possible measurement techniques are discussed in the context of trial conditions.
ESRO

N72-30364# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Sep. 1971 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, SEPTEMBRE 1971]
Sep. 1971 28 p In FRENCH and DUTCH
Avail: NTIS HC $3.50

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during September 1971 are presented.
ESRO

N72-30365# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON THE DIURNAL VARIATIONS IN THE THERMOSPHERE
M. N. Izakov, S. K. Morozov, and I. A. Yascenko 1972 19 p refs Presented at the 15th COSPAR Meeting, Madrid, 1972
(D-133) Avail: NTIS HC $3.00

Experimental data on thermospheric diurnal variations is compared with a theoretical model constructed for the equatorial thermosphere during the equinox. Infromation on thermospheric density was obtained by satellite drag data while diurnal variations of thermospheric temperature were obtained by incoherent radio scattering. It is concluded that winds influence the thermosphere and that the shape of the diurnal profile is variable.
ESRO

N72-30366# Institut Royal Meteorologique de Belgique, Brussels.
OZONE OBSERVATIONS Quarterly Report, 1969 [OBSERVATIONS D'OZONE LE TRIMESTRE 1969]
1972 47 p In FRENCH and DUTCH
(QR-1) Avail: NTIS HC $4.50

The ozograms contain designations for partial ozone pressure and atmospheric diffusion, air temperature, and mixture ratios at standard levels for January through March 1969.
ESRO

N72-30367# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Oct. 1971 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, OCTOBRE 1971]
Oct. 1971 28 p In FRENCH and DUTCH
Avail: NTIS HC $3.50

Geophysical data obtained at Dourbes, relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during October 1971, are presented.
ESRO

N72-30368# Institut Royal Meteorologique de Belgique, Brussels.
OZONE OBSERVATIONS Quarterly Report, 1969 [OBSERVATIONS D'OZONE 2E TRIMESTRE 1969]
1972 51 p In FRENCH and DUTCH
(QR-2) Avail: NTIS HC $4.75

Due to Dobson spectrophotometer technical difficulties in 1969 spectrophotometric total ozone measurements are not given. The presented ozonograms contain designations for partial ozone pressure and atmospheric diffusion, air temperature, and mixture ratios at standard levels for the April through June 1969.
ESRO

N72-30369# Ohio State Univ., Columbus. Dept. of Geodetic Science.
IMPLEMENTATION OF SUGGESTIONS FOR THE DIRECT COMBINATION OF SATELLITE AND GRAVIMETRIC DATA
Richard H. Rapp Dec. 1971 16 p refs
(Contract F19628-69-C-0127; AF Proj. 7600)
(AD-742286; DGS-167; AFCRL-72-0004; SR-21) Avail: NTIS CSCL 08/5

A modification of an existing orbit determination-analysis program where potential coefficients are solved for is discussed. The modifications include those dealing with the variational equations and the adjustment procedure that will allow mean anomalies to replace the potential coefficients as descriptions of the gravitational field of the earth. It is suggested that 184-15 degree equal area blocks be used as the unknown gravitational parameters. The terrestrial estimates of these blocks must be made from smaller subdivision blocks and then referenced to anomalies implied by a reference set of potential coefficients that are used for the reference orbit computation. It is suggested that the iteration of the orbital solution be carried out using a fixed set of coefficients. After the iteration has converged one last run should be made using the program modified to incorporate mean anomalies as unknowns. Author (GRA)

N72-30370# Stanford Univ., Calif. Radioscience Lab.
TWO RADAR TECHNIQUES FOR REMOTE MEASUREMENT OF ATMOSPHERIC PARAMETERS Final Report, 1 Nov. 1969 - 31 Dec. 1971
Michael S. Frankel and Edgar M. North, Jr. Jan. 1972 42 p refs
(Contract F19628-70-C-0041; AF Proj. 8628; SEL Proj. 3612)
(AD-742289; SU-SEL-72-001; AFCRL-72-0070) Avail: NTIS CSCL 04/1

Progress at Stanford on two methods of remote measurement of atmospheric parameters is reported. Meteor trail radar sets have been operated at Stanford University and Eglin Air Force Base, Florida, to measure upper atmosphere wind and density in the height region between 80 and 110 km. An experimental Radio Acoustic Sounding System has been constructed which is capable of measuring temperature profiles in the lower atmosphere, up to an altitude of one kilometer. Author (GRA)

N72-30371# TRW Systems, Redondo Beach, Calif.
IONOSPHERIC MODIFICATION EXPERIMENTS Final Technical Report, 30 Jun. 1971 - 30 Jan. 1972
A. Y. Wong, R. J. Taylor, D. Arnush, B. D. Bried, and C. F. Kennel Griffiss AFB, N. Y. RADC 30 Jan. 1972 13 p refs
(Contract F30602-71-C-0337; ARPA Order 1423)
(AD-742281; TRW-18565-6001-R0-00; RADC-TR-72-75) Avail: NTIS CSCL 04/1

A set of experiments were performed in order to investigate certain aspects of the effects of heating the ionosphere by a high power transmitter. These experiments, based on analogous laboratory experiments, consisted in exciting the ionosphere by a variety of methods using the ITS 2-megawatt transmitter and then simultaneously quick-look analyzing the reflected waves using a spectrum analyzer and recording them on analog magnetic tape for subsequent data reduction and analysis. Experiments were performed to determine the nonlinear behavior of electrons under the pump excitation. Author (GRA)

N72-30372# Utah State Univ., Logan. Electro-Dynamics Labs.
REDUCTION AND ANALYSIS OF NATAL FLIGHT DATA Final Report, 26 Feb. 1970 - 31 Oct. 1971
Ruey Y. Han, Lawrence R. Megill, and Clair L. Wyatt 11 Jan. 1972 28 p refs
(Contract F19628-70-C-0215; AF Proj. 8658)
(AD-742288; AFCRL-72-0018) Avail: NTIS CSCL 04/1

The (0-0) band of the infrared atmospheric system of molecular oxygen at 1.27 microns is a major feature of the atmospheric emission spectrum, both day and night. The emitting specis, 02(singlet Delta (g)), is closely associated with the ozone in the daytime and early evening. The production mechanism for the nighttime emission is not known. A rocket was launched about two hours after local sunset to observe the 02(singlet Delta (g)) emission from above. The resultant observations, while yielding only gross height resolution, did give an observations, of the 02 emission in a circle approximately 2000 km in diameter and covering approximately one hour and thirty minutes in local time and 22 degrees in latitude.
Author (GRA)

N72-30373# Woods Hole Oceanographic Institution, Mass.
SHORT ARM ELECTRIC FIELD MEASUREMENTS OF OCEAN CURRENTS
Albert J. Williams, III, Richard J. Jaffee, Peter F. Poranski, and Paul J. Simonetti ' Feb. 1972 92 p refs Prepared in cooperation with MIT, Cambridge
(Contract N00014-66-C-0241; Grant NSF GH-104; NR Proj. 083-004)
(AD-740133; WHOI-72-13) Avail: NTIS CSCL 08/3

The construction of a bottom mounted electromagnetic current meter which would measure the vertically-averaged conductivity weighted horizontal velocity is necessary for the determination of the true horizontal velocity vector by electromagnetic techniques. A towed surface instrument which is the first prototype for the bottom mounted instrument was constructed and tested during the course of the summer. A salt bridge used in conjunction with a valve switching arrangement permitted the induced electromotive force and the electrode offset potential to be easily determined. Extensive laboratory tests and several field experiments proved the reliability and effectiveness of this design. Field tests included towing the instrument at the ocean surface and emplantment of the instrument on the bottom in shallow water. Author (GRA)

N72-30374# Stanford Research Inst., Menlo Park, Calif.
CORRELATION OF RADAR ECHOES FROM THE AURORA WITH SATELLITE-MEASURED AURORAL PARTICLE PRECIPITATION Final Report, Mar. 1969 - Dec. 1971
Walter G. Chesnut, James C. Hodges, and Ray L. Leadabrand Dec. 1971 158 p refs
(Contract DASA01-67-C-0066; DASA Proj. NWET-K11BAXH; SRI Proj. 6548)
(AD-740814; DNA-2825F) Avail: NTIS CSCL 04/1

The characteristics of auroral particle precipitation as measured during 14 passes by the Lockheed OV1-18 satellite over Alaska have been compared with radar aurora simultaneously detected at 139 and 398 MHz beneath the satellite orbit. The radar aurora were measured using the SRI auroral radar located at Homer in southern Alaska. The satellite measured precipitation of protons with energies above 10 keV and precipitation of electrons with energies above 800 eV. All measurements were made near local midnight while the E-region was in darkness.
Author (GRA)

N72-30375# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.
RAY TRACING WITH NONLINEAR PROFILES
Norman L. Weinberg Apr. 1972 50 p refs
(Contract N00014-67-A-0012-0020)
(AD-742448; UM-RSMAS-72024) Avail: NTIS CSCL 08/10

In the report, the derivation of the general form of the acoustic ray paths for various non-linear profiles is developed. The most useful of these paths, the ellipse and hyperbola, are derived in a form suitable for use with sound velocity profiles encountered in the ocean. Expressions for travel time, initial angle, and spreading loss were also determined for the ellipse and hyperbola. Represented analytically was a typical sound velocity profile from the Straits of Florida which yields an ellipse for the upper region and a hyperbola for the lower region with the slope of the two curves constrained to be equal at the junction point. Author (GRA)

N72-30376# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
LINE-OF-SIGHT INTEGRATION OF DENSITY DISTRIBUTION FOR DISCRETE CHEMICAL RELEASES DIFFUSING IN A CONSTANT SHEAR FLOW
Antonio F. Quesada and Malcolm A. MacLeod 10 Nov. 1971 30 p refs
(AF Proj. 7635)
(AD-742257; AFCRL-ERP-375; AFCRL-71-0574) Avail: NTIS CSCL 04/1

The analytic expression for the number density of an initially

spherical gaussian puff diffusing in a constant shear flow is integrated along an arbitrary line of sight. It is shown that the sum of the projected gaussian half-widths squared is a cubic function of the time, with coefficients that depend on the geometry, the initial puff radius, the wind shear components, and the ambient diffusion coefficient. This result establishes the basis for determining these parameters from experimental data by least-squares techniques. Author (GRA)

N72-30377# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
IMPROVEMENTS IN IONOSPHERIC FORECASTING CAPABILITY
Charles M. Rush 28 Feb. 1972 64 p refs
(ILIR Proj. 00-01)
(AD-742258; AFCRL-ERP-387; AFCRL-72-0138) Avail: NTIS CSCL 04/1

The results of a study undertaken to determine the feasibility of employing synoptic mapping to improve ionospheric forecasting capabilities are presented. Using electron density data obtained from 16 ionosonde stations located in North America and Greenland during the time period mid-April through July 1970, the temporal and spatial variability of the ionosphere was assessed. Author (GRA)

N72-30378# Colorado Univ., Boulder. Dept. of Astro-Geophysics.
IONIZATION AND KINEMATICS OF YELLOW-LINE CORONAL REGIONS
William J. Boardman and Donald E. Billings 1972 36 p refs
(Contract Nonr-393(04); NR Proj. 046-740)
(AD-740725) Avail: NTIS CSCL 03/2

The authors computed the ionization of Ca XV from observations of the strengths of the coronal lines lambda 5694 and lambda 5446, and the neighboring regions of the continuum. They then compared this with a theoretical ionization curve including dielectronic recombination. Discrepancies are discussed and explanations suggested in the form of turbulence and/or ordered mass motion. Finally estimates are calculated of the dimensions of the observed condensations along the line of sight. Author (GRA)

N72-30379# Pennsylvania State Univ., University Park. Ordnance Research Lab.
DEVELOPMENT, INSTALLATION, AND DATA ANALYSIS FOR A SCANNING RESEARCH RECEIVER EMPLOYED AT THE AIR FORCE GEOPOLE OBSERVATORY, THULE, GREENLAND Final Report, 15 Dec. 1970 - 15 Dec. 1971
Ernest J. Oelbermann and Charles R. Smitley 6 Mar. 1972 53 p refs
(Contract F19628-71-C-0103; AF Proj. 7661)
(AD-741784; AFCRL-72-0131) Avail: NTIS CSCL 04/1

The report summarizes research and development connected with the use of a scanning VLF receiver at Thule, Greenland, to study polar cap disturbances during PCA:s. The report describes the equipment, the quiet-day solar controlled patterns of a number of polar path VLF circuits, and VLF amplitude perturbations produced by solar proton events which occurred on September 1, October 3, and December 2, 1971. It is concluded that the VLF amplitude data are very sensitive and can be used to provide detection and tracking information on the movement of PCA centers across the polar cap. It is recommended that the scanned bandwidth be reduced and the sweep rate speeded up to shorten dead time and improve the time resolution of the system. Author (GRA)

N72-30380# Emmanuel Coll., Boston, Mass.
FIELD ALIGNED E- AND F-LAYER BACKSCATTER OBSERVATIONS Interim Report
Sunanda Basu and Robert L. Vesprini Jan. 1972 58 p refs
(Contract F19628-71-C-0250; AF Proj. 414L)
(AD-740964; AFCRL-72-0128; SR-1) Avail: NTIS CSCL 04/1

In a reanalysis of the HF (19 MHz) backscatter data from Plum Island, ME. The occurrence of field aligned echoes from the E and F layers, called FAE(E) and FAE(F) respectively, was studied in detail. FAE(E) during quiet magnetic conditions (K(Fr)0-3) is a nighttime phenomenon with a definite maximum during the summer, when it is accompanied by groundscattered E(s). A weaker maximum is observed in the winter.
Author (GRA)

N72-30381# Naval Postgraduate School, Monterey, Calif. Dept. of Oceanography.
THE MEASUREMENT AND CORRELATION OF SOUND VELOCITY AND TEMPERATURE FLUCTUATIONS NEAR THE SEA SURFACE M.S. Thesis
Charles Jack Duchock, Jr. Mar. 1972 99 p refs
(AD-741142) Avail: NTIS CSCL 08/10

The temporal variations of salinity, temperature, water turbulence components, surface wave height, acoustic amplitude and acoustic velocity were studied statistically by computing the auto-correlations and power spectral densities. Correlation times were high for temperature fluctuations with a decay time (e to the -1 power) being of the order of forty seconds or greater for temperature and of the order of two seconds for the other parameters. All parameters were shown to exhibit maximum energy at the periods of the predominant surface wave energy.
Author (GRA)

N72-30382# McGill Univ., Montreal (Quebec). Faculty of Graduate Studies and Research.
THE REMOTE SENSING OF SURFACE RADIATIVE TEMPERATURE OVER BARBADOS
Benjamin J. Garnier Dec. 1971 60 p refs
(Contract N00014-68-C-0307; NR Proj. 389-152)
(AD-741188; TR-3) Avail: NTIS CSCL 04/1

The remote sensing of surface radiative temperature over Barbados was undertaken using a PRT-5 attached to a light aircraft. Traverses across the centre of the island, over the rugged east coast area, and the urban area of Bridgetown were undertaken at different times of day and night in the last week of June and the first week of December, 1969. These traverses show that surface variations in long-wave radiation emission lie within plus or minus 5% of the observations over grass at a representative site. The quick response of the surface to sunset and sunrise was noticeable, as was the rapid early heating of east-facing slopes. Surface variations were negligible at night, when the island's surface temperatures were a few degrees below sea temperature. Author (GRA)

N72-30383# Army Foreign Science and Technology Center, Charlottesville, Va.
WAVELENGTH DEPENDENCE OF ATMOSPHERIC AEROSOL SCATTERING INDICES
T. P. Toropova 18 Apr. 1972 9 p refs Transl. into ENGLISH of mono. "K Voprosu o Zavisimotsi Aerozolnoi Indikatrisy Passeyaiya v Atmosfere of Diliny Volny"
(AD-741110; FSTC-HT-23-401-72) Avail: NTIS CSCL 04/1

The present work attempts to touch on the question of the possibility of bringing out some of the properties of aerosol indices scattering according to the data available regarding the dispersion of sky brightness along the sun almucantarate in any relative units, obtained in various wave lengths. Author (GRA)

N72-30384# Colorado School of Mines, Golden.
RECOMMENDATIONS OF THE WORKING GROUP ON ELECTROMAGNETIC METHODS
George V. Keller 6 Mar. 1972 23 p
(Contract N00014-71-A-0430-0002)
(AD-740122) Avail: NTIS CSCL 08/7

The report discusses the problem of measuring the minimum electrical conductivity in the earth's crust, with special reference to the possibility of longrange communications through such a low-conductivity region. GRA

N72-30385# North Carolina State Univ., Raleigh.
HYDROMAGNETIC WAVE PHENOMENA IN THE MAGNETOSPHERE Final Report, 2 Jan. 1967 - 31 Dec. 1970
Alvin W. Jenkins, Jr. 1 Feb. 1971 30 p refs
(Contract F19628-67-C-0152; AF Proj. 8601)
(AD-740610; AFCRL-72-0207) Avail: NTIS CSCL 04/1

The propagation characteristics for three model magnetospheres are compared for hydromagnetic waves in the micropulsations frequency range, 0.0001 rad/sec omega - 1.0 rad/sec. One model is of a plane, layered medium over a plane, conducting earth. A second model is one composed of concentric cylindrical shells of plasma surrounding a conducting, cylindrical earth. In the first, the plane model magnetic field is horizontal, but varies with height. In the second, the stratic magnetic magnetic field is parallel to the cylindrical axis, but again varies with height. The transmission coefficient for the amplitude of the magnetic field of an incident plane hydromagnetic wave is computed as a function of frequency for both models, and the results are compared. The scattering and diffraction effects present in the model with curved surfaces substantially reduce the transmission coefficient at higher frequencies. Author (GRA)

N72-30386# Johns Hopkins Univ., Baltimore, Md.
SOME ASPECTS OF TURBULENCE IN STRATIFIED FLUIDS
Robert R. Long Apr. 1972 32 p refs
(Contract N00014-67-A-0163-0013; NR Proj. 061-198)
(AD-740339; TR-1-SER-C) Avail: NTIS CSCL 04/1

The report contains a discussion of some aspects of stratified, shearing flow. The importance of the subject for geophysical fluid mechanics is implicit in the turbulent nature of the atmosphere and oceans. Energy production and energy loss are considered first and an interpretation is given of the four basic terms in the energy equation. In particular, suggestions are made for separate processes in which disturbance energy is gained from the shear and lost to potential energy. The common layered structure of geophysical systems and stratified laboratory systems is described and two proposals are advanced that smooth density profiles may be unstable in the presence of turbulence. The suggestion is made that the density gradient in homogeneous layers may be dynamically important. The problem of the growth and maintenance of turbulence in stratified flows is presented. Evidence from laboratory experiments indicates that turbulence can be maintained at values of the Richardson number considerably in excess of 1/4. The paper concludes with some inferences and observations relative to turbulence in stratified flow. Author (GRA)

N72-30387# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex. Atmospheric Sciences Lab.
ON CALCULATION OF DYNAMIC ERROR PARAMETERS FOR THE RAWINSONDE AND RELATED SYSTEMS
Water B. Miller Jan. 1972 29 p refs
(DA Proj. 1T0-61102-B-53-A)
(AD-741344; ECOM-5422) Avail: NTIS CSCL 17/9

Techniques for determination of dynamic error parameters, or those obtained from real trajectories, are studied in detail, with particular attention being given to dependence of estimates on trajectory and to shortcomings of estimation procedures which ignore such dependence. A technique is presented to determine dynamic estimates of error parameters for the rawinsonde and is verified by data. The data indicate that error parameters so determined are smaller than given by most earlier studies and tend to conform to error claims made for the AN/GMD- (1A) Rawinset. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N72-30388*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
ELECTROMAGNETIC DAMPER SYSTEM FOR GROUND WIND LOAD STUDIES Final Report
L. P. Scott May 1972 61 p refs
(Contract NAS8-26774)
(NASA-CR-123797; HREC-6674-1; LMSC-HREC-D225690)
Avail: NTIS HC $5.25 CSCL 14B

The design, fabrication, and adaptation of a model damper system to the 5.5% aeroelastic model of the Saturn 1B/Skylab launch vehicle are reported. The damper is dynamically calibrated over the desired range of additive damping for model conditions prior to wind tunnel testing. Author

N72-30389*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
FABRICATION, TEST AND DEMONSTRATION OF CRITICAL ENVIRONMENT MONITORING SYSTEM Final Report
Kip W. Heimendinger Jun. 1972 114 p
(Contract NAS8-27300)
(NASA-CR-123782; LMSC-HREC-D225985; HREC-7300-5)
Avail: NTIS HC $7.75 CSCL 14B

Design and performance of an analytical system for the evaluation of certain environmental constituents in critical environmental areas of the Quality Reliability and Assurance Laboratory are reported. Developed was a self-contained, integrated, minimum sized unit that detects, interrogates, and records those parameters of the environment dictated for control in large storage facilities, clean rooms, temporarily curtained enclosures, and special working benches. The system analyzes humidity, temperature, hydrocarbons particle size, and particle count within prescribed clean areas. Author

N72-30390*# Stanford Univ., Calif. W. W. Hansen Laboratories of Physics.
PRECISION STAR-TRACKING TELESCOPE Final Report
W. M. Fairbank and C. W. F. Everitt Jul. 1972 59 p
(Contract NAS8-25705)
(NASA-CR-123811) Avail: NTIS HC $5.00 CSCL 20F

The design, construction, and preliminary testing of a new high accuracy star tracking telescope for the laboratory model of the Stanford gyro relativity experiment are described. The function of the telescope in the final flight experiment is to define (by reference to a suitable star) a direction in space for comparison with the relativistic precession of a group of gyroscopes. The design of the telescope has been strongly affected by designs for other portions of the overall experiments, for example the gyroscopes, the attitude control system of the satellite, and the instrumentation system used in processing relativity data. Main goals for the star tracker are: (1) independent readout of angular position in two planes; (2) absolute null stability over a one year period of mechanical parts; (3) readout linear to 0.001 arc-seconds over + or - 0.05 arc-second; (4) noise performance leading to a resolution of 0.05 arc-second in 0.1 second observation time of the chosen reference star; and (5) provision for automatic gain control capable of matching the gains of the gyroscopes and telescope readouts to 1% or better. Author

N72-30391*# Rensselaer Polytechnic Inst., Troy, N.Y. School of Engineering.
COMPARISON OF TWO GAS CHROMATOGRAPH MODELS AND ANALYSIS OF BINARY DATA
Paul S. Keba and Philip T. Woodrow 15 Jul. 1972 59 p refs (Grant NGL-33-018-091)
(NASA-CR-127911; RPI-MP-27) Avail: NTIS HC $5.00 CSCL 14B

The overall objective of the gas chromatograph system studies is to generate fundamental design criteria and techniques to be used in the optimum design of the system. The particular tasks currently being undertaken are the comparison of two mathematical models of the chromatograph and the analysis of binary system data. The predictions of two mathematical models, an equilibrium absorption model and a non-equilibrium absorption model exhibit the same weaknesses in their inability to predict chromatogram spreading for certain systems. The analysis of binary data using the equilibrium absorption model confirms that, for the systems considered, superposition of predicted single component behaviors is a first order representation of actual binary data. Composition effects produce non-idealities which limit the rigorous validity of superposition. Author

N72-30392*# Metropolitan Washington Council of Governments, D.C. Dept. of Health and Environmental Protection.
AN ASSESSMENT OF REMOTE SENSOR IMAGERY IN THE DETERMINATION OF HOUSING QUALITY DATA
Harry J. Mallon and Joan Y. Howard Nov. 1971 52 p refs (Contract NASA Order W-13318; Contract DI-14-08-0001-12708)
(NASA-CR-127865; USGS-IR-NASA-228) Avail: NTIS HC $4.75 CSCL 14E

Selected census tracts in the metropolitan Washington area were examined using varying scales of aerial photography. Observable characteristics of housing and neighborhoods were assessed to determine feasibility of providing data on housing stock and quality and neighborhood condition from the imagery. Small scale imagery is shown to be of relatively marginal value in providing much of the data in the detail required, but can be useful for general survey purposes. Author

N72-30393*# Techtran Corp., Glen Burnie, Md.
CALCULATION OF THE VISIBLE CHARACTERISTICS OF PHOTOGRAPHIC OBJECTS. EXAMPLES OF PHOTOGRAPHY OF THE SURFACE OF VENUS
A. S. Panfilov Washington NASA Aug. 1972 19 p refs Transl. into ENGLISH the publ. "Raschet Opticheskikh Kharakteristik Obyektov Syemki; Primer Syemki Poverkhnosti Venery" Moscow, Acad. of Sci., 1972 26 p (Contract NASw-2037)
(NASA-TT-F-14370) Avail: NTIS HC $3.00 CSCL 14E

The problems of calculating the visible characteristics of photographic objects is discussed including the brightness, luminosity, and contrast of the objects. On the basis of the general relationships, numerical relationships were obtained for a given scheme of the object or its details. The application of the object technique to the photography of the surface of Venus is given using natural, artificial, and combined illumination. Author

N72-30394*# Wintec Corp., Los Angeles, Calif.
ETCHED TITANIUM DISC FILTER (10 MICRON, 20 MICRON)
Feb. 1972 29 p Prepared for JPL (Contracts NAS7-100; JPL-562636)
(NASA-CR-127858; TR-258) Avail: NTIS HC $3.50 CSCL 14B

A series of development tests was conducted to evaluate the performance characteristics of the stacked, etched-titanium T-pattern disk filter. The material and configuration of the discs used, the test fixtures, test methods and systems, and the resultant test data are described. The discussion includes: bubble-point (micron calibration), compression loads, fluid flow characteristics, effects of filter housing designs, and disk orientation. Author

N72-30395*# Wintec Corp., Los Angeles, Calif.
JPL P/N 71 X 12400 ETCHED DISC FILTER
1972 4 p Prepared for JPL (Contract NAS7-100)
(NASA-CR-127916; TR-262) Avail: NTIS HC $3.00 CSCL 14B

The results are presented of a glass bead test conducted with a JPL P/N 71 x 12400 etched disk filter assembly to determine the largest diameter spherical glass bead that would transmit through the filter assembly. It was found that the largest glass bead transmitted was 16 microns in diameter. F.O.S.

N72-30396*# Naval Research Lab., Washington, D.C. Space Science Div.
THE NRL OSO-4 BRAGG CRYSTAL SPECTROMETER INSTRUMENT Interim Report
J. F. Meekins 27 Jul. 1972 25 p ref Sponsored by NASA
(NASA-CR-127857; NRL-7423) Avail: NTIS HC $3.50 CSCL 14B

Two Bragg crystal spectrometers were placed on the OSO-4 satellite to study solar flare plasmas by their spectral emissions. The solar flare plasma parameters were measured with these spectrometers, which together covered a total wavelength range of 0.6 to 8.4 A. With these instruments, knowledge could be gained into the mechanisms governing the plasma behavior in the high temperature-low density regime of flare production and in solar evolution and elemental abundances in the sun. However, spacecraft limitations forced many restrictions on the design of the instrument, so the final instrument could not measure all the solar flare plasma state parameters. Author

N72-30397# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
REFERENCE TABLES FOR LOW-TEMPERATURE THERMOCOUPLES
Larry L. Sparks, Robert L. Powell, and William J. Hall Jun. 1972 62 p refs
(NBS-Mono-124; LC-74-186212) Avail: SOD $0.60 as C 13.44:124

The experimental program to establish low temperature reference tables for the commonly used thermocouples has been completed. Details of the experimental system, instrumentation, data analysis, error analysis, and materials tested are given in order to allow the user to better evaluate and apply the results. The results include: (1) Reference tables for thermocouple types E, K, and T, both as E = f(T) and T = f(E). The shorter f(E) tables have a 0 C (273.15 K) reference temperature while all other tables have a 0 K reference temperature. (2) Reference tables for Pt and Ag-28 at % Au vs the materials used in thermocouple types E, K, and T. These data are presented as E = f(T) only. (3) Orthogonal polynomials and the associated coefficients necessary to generate the data with reduced order approximations. (4) Power series coefficients for full precision reproduction of the reference data. The data presented in the E = f(T) tables cover the temperature range from 0 to 280 K. The T = f(E) tables cover the temperature ranges from 273.15 K down to the lowest temperatures allowed by table resolution. Author

N72-30398*# Zenith Radio Corp., Evanston, Ill. Government Engineering Dept.
NEUTRON RADIOGRAPHIC VIEWING SYSTEM Final Report
Feb. 1972 118 p refs (Contract NAS8-30070)
(NASA-CR-123802; Rept-8661-FER) Avail: NTIS HC $8.00 CSCL 14B

The design, development and application of a neutron radiographic viewing system for use in nondestructive testing applications is considered. The system consists of a SEC vidicon camera, neutron image intensifier system, disc recorder, and TV readout. Neutron bombardment of the subject is recorded by an

image converter and passed through an optical system into the SEC vidicon. The vidicon output may be stored, or processed for visual readout. Author

N72-30399*# Parametrics, Inc., Waltham, Mass.
DESIGN, FABRICATION AND CALIBRATION OF ALPHA PARTICLE DENSITOMETERS FOR MEASURING PLANETARY ATMOSPHERIC DENSITY Final Report, Jan. 1970 - May 1972
Bach Sellers, Jean Luc Hunerwadel, and Frederick A. Hanser May 1972 40 p refs
(Contract NAS1-9731)
(NASA-CR-112116) Avail: NTIS HC $4.00 CSCL 20F

An alpha particle densitometer was developed for possible application to measurement of the atmospheric density-altitude profile on Martian entry. The device uses an Am-241 radioactive-foil source, which emits a distributed energy spectrum, located about 25 to 75 cm from a semiconductor detector. System response - defined as the number of alphas per second reaching the detector with energy above a fixed threshold - is given for Ar and CO2. The altitude profile of density measurement accuracy is given for a pure CO2 atmosphere with 5 mb surface pressure. The entire unit, including dc-dc converters, requires less than 350 milliwatts of power from +28 volts, weighs about 0.85 lb and occupies less than 15 cubic inches volume. Author

N72-30400# Joint Publications Research Service, Arlington, Va.
STATE STANDARD 10891-64 NEGATIVE PHOTOGRAPHIC FILMS FOR MICROFILMING
P. Kh. Pruss and G. G. Kareva 2 Aug. 1972 5 p ref Transl. into ENGLISH from Zh. Nauch. Prikl. Fotogr. Kinomatogr. (Moscow), v. 11, no. 5, 1966 p 382-383
(JPRS-56672) Avail: NTIS HC $3.00

Test data on negative microfilms types Mikrat-300 and Mikrat-600 are reported. It was found that the numerical value of the film rating is unsubstantiated and should therefore be removed from the standard. Author

N72-30401# Joint Publications Research Service, Arlington, Va.
COMPUTING CAMERAS WITH PRISM COMPENSATION
Ye. A. Tarantov 22 Aug. 1972 14 p refs Transl. into ENGLISH from Zh. Nauch. Prikl. Fotogr. Kinematogr. (USSR), v. 17, no. 1, 1972 p 8-16
(JPRS-56836) Avail: NTIS HC $3.00

The purpose of this report is to refine certain theoretical points in the operating theory of the optical prism-type compensator for use in computing cameras with continuous pull-down of film. Author

N72-30402# Joint Publications Research Service, Arlington, Va.
THE SIMPLEST HEAT SENSORS UNDER CONDITIONS ARBITRARILY VARYING IN TIME TEMPERATURE OF MEDIUM AND HEAT TRANSFER COEFFICIENT
A. M. Azizov 18 Aug. 1972 12 p refs Transl. into ENGLISH from Teplofiz. Vys. Temp. (USSR), no. 4, 1967 p 655-662
(JPRS-56806) Avail: NTIS HC $3.00

The analytical expressions that were obtained for the distribution of temperature in a heat sensor (plate, cylinder, sphere) when the temperature of the medium and coefficient of heat transfer are arbitrary functions of time, are presented. Author

N72-30403*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF THE USE OF MICROWAVE IMAGE LINE INTEGRATED CIRCUITS FOR USE IN RADIOMETERS AND OTHER MICROWAVE DEVICES IN X-BAND AND ABOVE Final Report
R. M. Knox, P. P. Toulios, and G. Y. Onoda Aug. 1972 204 p refs
(Contract NAS1-10716; IITRI Proj. E6200)
(NASA-CR-112107) Avail: NTIS HC $12.25 CSCL 14B

Program results are described in which the use of a/high permittivity rectangular dielectric image waveguide has been investigated for use in microwave and millimeter wavelength circuits. Launchers from rectangular metal waveguide to image waveguide are described. Theoretical and experimental evaluations of the radiation from curved image waveguides are given. Measurements of attenuation due to conductor and dielectric losses, adhesives, and gaps between the dielectric waveguide and the image plane are included. Various passive components are described and evaluations given. Investigations of various techniques for fabrication of image waveguide circuits using ceramic waveguides are also presented. Program results support the evaluation of the image line approach as an advantageous method for realizing low loss integrated electronic circuits for X-band and above. Author

N72-30404# Oak Ridge National Lab., Tenn.
HIGH RESOLUTION SPECTROMETER SYSTEM WITH PARTICLE IDENTIFICATION FOR 1 THROUGH 60 MeV HYDROGEN AND HELIUM PARTICLES
F. E. Bertrand, W. R. Burrus, N. W. Hill, T. A. Love, and R. W. Peelle Jan. 1972 51 p refs Sponsored by AEC
(ORNL-TM-3669) Avail: NTIS

A coincidence semiconductor spectrometer system based on a Ge(Li) total absorption detector was applied to the simultaneous spectroscopy of all charge -1 and -2 particles from targets bombarded with protons with energy up to 62 MeV. Output spectra cover the range from the full energy down to a 1- to 5-MeV threshold, which depends on particle type. The method for choosing the thicknesses for the two Delta E detectors is discussed, and unusual features of the system are described. Particles too slow to penetrate the first Delta E counter were sorted according to mass by using the flight-time vs E discrimination, while the more energetic particles were separated using two sets of Delta E x E discrimination. Germanium detectors thick enough to stop 60-MeV protons were used with particles entering perpendicular or parallel to the field lines, and in either case the only significant inactive region in the path of the detected particles was the protective foil over the Ge(Li) detector. Author (NSA)

N72-30405# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DESIGN DESCRIPTION OF A COMPUTER CONTROLLED NEUTRON TUBE TESTER
W. M. Rowe 20 Oct. 1971 17 p ref
(Contract AT(29-2)-656)
(GEPP-91) Avail: NTIS

The test equipment (PT1533) described in this report automatically tests neutron generator tubes. These neutron generator tubes are pulsed devices which emit bursts of 14-MeV neutrons in response to certain input stimuli: ion source current and target voltage. The particular reaction of interest is the tritium-deuterium reaction in which ions are accelerated under the force of an electric field. The tester must provide all the inputs required by the tubes and measure the neutron outputs. The tester uses a General Electric GE-PAC 30 minicomputer for controlling test parameters and acquiring and processing test data. Experience indicates that the test significantly improves uniformity of test conditions. The usual operator errors are completely eliminated. The automatic data analysis and real-time quality decisions materially reduce the time between testing and knowledge of product acceptability. Author (NSA)

N72-30406# Iowa State Univ. of Science and Technology, Ames.
Ac POTENTIOMETRIC METHOD FOR HIGH TEMPERATURE RESISTIVITY AND PHASE BOUNDARY DETERMINATION
P. Chiotti 1971 19 p refs Prensented at Symp. on the Study of Crystalline Transformations at High Temp. above 2000 K, Odeillo, France, 27 Sep. 1971 Sponsored by AEC
(IS-2683; Conf-710926-2) Avail: NTIS

An alternating current potentiometric method for determining the resistance of metals or alloys at high temperatures is described. The specimen in the form of a rod is mounted between water-cooled electrodes and is heated by passing an ac current through it. The potential developed between two probes about 1.0 cm apart which make contact with the middle part of the specimen is balanced against a potential across a known resistance in the secondary of a current transformer whose primary is in series with the specimen. The transformer maintains a constant ratio between the primary and secondary currents and consequently the unknown resistance between the probes on the specimen is directly proportional to the known resistance in the secondary. Author (NSA)

N72-30407# Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Reactions.
TECHNIQUE FOR MANUFACTURING SPECTROMETRIC DELTA E-DETECTORS
G. N. Zorin, V. F. Kushniruk, and Yu. P. Kharitonov 1972 12 p refs In RUSSIAN; ENGLISH summary
(JINR-P13-6247) Avail: AEC Depository Libraries

A technique is described for manufacturing silicon surface-barrier Delta E detectors that are 15 to 140 microns thick with the plane-parallelity not less than 0.5 microns on the diameter of 20 to 28 mm having a working area of 0.2 to 1.5 sq cm. Author (NSA)

N72-30408# European Space Research Inst., Frascati (Italy).
CONSTRUCTION AND OPERATION OF A WEBER TYPE GRAVITATIONAL WAVE DETECTOR AND OF A DIVIDED BAR PROTOTYPE
D. Bramanti and K. Maischberger 1972 23 p refs Submitted for publication
Avail: NTIS HC $3.25

The construction, operation, and characteristics of a Weber gravitational wave detector is described. Its thermal noise is observed, and for comparison, the operation of a prototype divided-bar resonator is considered. Significant parameters of the detectors are given. ESRO

N72-30409# Laboratoire Central de Recherches Thomson, Orsay (France).
APPLICATION OF PHOTOCHROMIC PROCEDURES TO THE OPTICAL PROCESSING OF ELECTRIC SIGNALS Final Report [UTILISATION DE PROCEDES PHOTOCHROMIQUES POUR LE TRAITEMENT OPTIQUE DE SIGNAUX ELECTRIQUES RAPPORT FINAL]
J. C. Bellamy 16 Mar. 1970 40 p In FRENCH
(Contract DRME-67-34-424)
(LCR-DR-1-70-44/1/R) Avail: NTIS HC $4.00

Several methods for real time and time delay optical processing of sonar type electrical signals with a m sec to 1 sec time duration are described. The principle of the method which consists of recording the signal on photosensitive material (photochromatic material) is presented. Different methods which use photochromic materials are described and their performance compared. They include the flying spot cathode ray tube correlator, ribbon correlator, and optical processing of electric signals. The performance characteristics of various photochromic materials and different ways of deposition are discussed, with emphasis on the American photochromic field. ESRO

N72-30410# Battelle Inst., Frankfurt am Main (West Germany).
EXPERIMENTAL VERIFICATION AND ASSESSMENT OF AN IR RADIATION MODULATOR BASED ON A FABRY-PEROT ETALON
E. G. Lierke Nov. 1971 121 p refs
(Contract ESTEC-1211/70)
(ESRO-CR-62) Avail: NTIS HC $8.00

The possibility to modulate infrared radiation in the 14 to 16 micron band by means of a Fabry-Perot cavity was investigated theoretically and experimentally. The experimental results verified that a modulation of about 60 percent in the audio range is achievable by micromovements of the etalon even for converging beams corresponding to f numbers between 1 and 2. The plate-drive mechanism is based on a tuning-fork principle. This mechanism is investigated in connection with required gap-width variation of the Fabry-Perot cavity. The tuning-fork principle constitutes a simple means for gap-width variation using low power and voltage. The device permits easy temperature compensation and appears reliable and suitable for use in the space environment. Author (ESRO)

N72-30411# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
MEASUREMENT OF THE PHOTOIONIZATION CROSS SECTION OF Ba I IN THE SPECTRAL REGION BETWEEN 2400 AND 2100 A USING THE ATOMIC BEAM METHOD [MES SUNG DES PHOTOIONISATIONSQUERSCHNITTS VON BA I IM SPEKTRALBEREICH VON 2400-2100 A MIT EINER ATOMSTRAHLMETHODE]
Herbert Schulte Mar. 1972 70 p refs In GERMAN
(MPI-PAE/Extraterr-63) Avail: NTIS HC $5.50

The photoionization cross section of barium was determined in the spectral range from 2400 to 2100 A from absolute measurement of the neutral particle density, the UV radiation intensity, and the ionization rate, of an optically thin barium atomic beam. A crossed beam method is used in which a Ba atomic beam is crossed by a UV light beam. The Ba-ions and electrons produced in the intersection are separated by an electric field and counted with multipliers. A rough mass analysis is reached by recording the delayed coincidences. Results of measurements are compared with existing data and are found to be consistent. ESRO

N72-30412# Max-Planck-Institut fuer Stromungsforschung, Gottingen (West Germany).
VELOCITY MEASUREMENTS IN FLUIDS BY THE OPTICAL DOPPLER EFFECT
Hartmut H. Bossel, W. J. Hiller, and G. E. A. Meier Oct. 1971 70 p refs In GERMAN; ENGLISH summary
(Rept-7/1971) Avail: NTIS HC $5.50; Max-Planck-Inst. fuer Stroemungsforsch.: 18, 50 DM

Several optical systems for the velocity measurement in fluids by the crossbeam and reference beam methods are examined. All are of simple design and do not require critical alignment. The beam splitting and polarizing properties of Wollaston prisms are used to develop a crossbeam-difference method, which suppresses practically all noise signals, and which raises the signal-to-noise ratio significantly. The automatic beam superposition properties of the Wollaston prism lead to a reference beam method which does not require any beam alignment for heterodyning. The method is particularly well suited for application to simultaneous two- and three-dimensional measurements. Characteristic properties of the crossbeam and reference beam methods are compared. Author (ESRO)

N72-30413# European Space Research and Technology Center, Noordwijk (Netherlands).
A VARIABLE TEMPERATURE REFERENCE JUNCTION FOR THERMOCOUPLES DEVELOPED FOR THE MEASUREMENT OF SPACECRAFT TEMPERATURES DURING THERMAL VACUUM TESTS
L. Simons, A. Voordijk, and J. B. Walker Mar. 1971 35 p refs
(ESRO-TN-111-ESTEC) Avail: NTIS HC $3.75

A reference junction for thermocouples is described. This instrument has been specially developed to perform whilst installed in the hostile environment of a thermal vacuum chamber. Its use during thermal balance testing will greatly simplify the work of data transmission from a rotating spacecraft, whilst maintaining or possibly improving measurement accuracy. The unit makes it possible to use thermocouples in the testing of spacecraft that normally spin in orbit, without introducing test restraints of the kind required by conventional hard-line signal-transmission devices. The development work is reported

and a small (10 cm x 10 cm x 10 cm) 140-channel unit for copper/Constantan thermocouples is described in detail.
Author (ESRO)

N72-30414# Army Materials and Mechanics Research Center, Watertown, Mass.
DEVELOPMENT OF A HIGH PRESSURE MEDIUM VELOCITY HELIUM GUN FOR FIRING 17 GRAIN FRAGMENT SIMULATION
Joseph M. Rogers Mar. 1972 9 p refs
(DA Proj. 1T0-62105-A-329)
(AD-742211; AMMRC-TR-72-11) Avail: NTIS CSCL 14/2

The work described in this report was undertaken to develop a gun using compressed helium as a propellant to fire a 17-grain fragment simulator at medium velocity range with small dispersion in velocity. The resultant helium gun has provided missile velocities ranging from 100 to 1700 fps with acceptably small velocity dispersion. This system has furnished a method of studying ballistic impact and penetration phenomena of single and composite polymeric materials and fabrics under closely controlled impact conditions. Author (GRA)

N72-30415# Army Foreign Science and Technology Center, Charlottesville, Va.
EQUIPMENT AND DEVICES FOR PROGRAMMED FATIGUE TESTING
E. G. Buglov, E. Ya. Filogov, M. E. Garf, V. E. Pavlovskii, and O. B. Balakovskii 22 Mar. 1972 219 p refs Transl. into ENGLISH of the mono. "Mashiny i Pribory Dlya Programmnykh Ispytanii na ustalost"
(AD-742113; FSTC-HT-23-513-72) Avail: NTIS CSCL 14/2

The monograph summarizes the experience of designing, computing, and dynamic testing of programmed testing machines and various control systems, as well as some of the devices for the investigation of the kinetics of fatigue destruction. GRA

N72-30416# Army Foreign Science and Technology Center, Charlottesville, Va.
GYROTHEODOLITES
V. Y. Torochkov 27 Jan. 1972 153 p refs Transl. into ENGLISH from the book "Girotrodolitii" Moscow, Nedra Publ. House, 1970
(AD-741713; FSTC-HT-23-1277-71) Avail: NTIS CSCL 17/8

An attempt to systematize the uncoordinated information in gyrotheodolites and methods of working with them is offered. In setting forth the principle of operation and the functional connections of the various gyrotheodolite system the physical processes taking place in the instrument are concentrated on. Together with the above the first chapter presents information on the theory of gyroscopes. Also discussed are gyrotheodolites in the research stage. Part of the book is devoted to measurements with gyrotheodolites, methods of appraising the quality of the work of the instrument and its errors. Considered are questions connected with automation of measurement, distant transmission of the results of measurements, and the possibility of constructing these instruments with aperiodic transitional processes and without introduction of a constant correction. Author (GRA)

N72-30417# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
FEASIBILITY STUDY OF THE PULSED GAS ANALYSER FOR TOXIC VAPOR DETECTION IN THE MINUTEMAN 3 ENVIRONMENT Final Report, Jun. 1971 - Feb. 1972
William W. Bursack and Roger P. Keller Mar. 1972 78 p refs
(Contract F04611-71-C-0059)
(AD-741903; AFRPL-TR-72-33; Rept-12658-FR1) Avail: NTIS CSCL 14/2

A program was carried out for demonstrating the feasibility of a new concept for detecting and measuring monomethyl hydrazine (MMH) and nitrogen dioxide (NO2) in the Minuteman III environment. A review of candidate methods for detection and measurement of MMH and NO2 leakage vapors was made. The Pulsed Gas Analyzer (PGA) concept was selected and a feasibility demonstration was made. This method was shown to have the required detectivity and measurement response for these materials. During the program, tests were run to evaluate performance of the laboratory model under extremes of humidity and temperature as well as in the presence of contaminate materials at relatively high concentrations. The logic scheme used for MMH and NO2 detection was based on the use of only two mass numbers in the mass spectra of these materials.
Author (GRA)

N72-30418# ARO, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC TESTING OF WING SECTIONS USING THE LASER DOPPLER VELOCIMETER Final Report, 19 Aug. 1970 - 30 May 1971
R. L. Parker AEDC Apr. 1972 32 p refs
(Contract F40600-72-C-0003; AF Proj. 8219)
(AD-740901; AEDC-TR-71-264) Avail: NTIS CSCL 14/2

An experimental program was conducted in the wind tunnel to ascertain velocity distribution about a wing section at various angles of attack using a laser Doppler velocimeter (LDV) and conventional pressure measuring techniques. In addition, an analytical method was developed to determine the pressure distribution over an arbitrary airfoil surface given the geometry and coefficient of lift. The results of the different measurement techniques are compared with the analytical computations. Agreement between experimental data and fluid flow theory was obtained. GRA

N72-30419# Ballistic Research Labs., Aberdeen Proving Ground, Md.
LASER DOPPLER SHIFT VELOCIMETER
Faustin N. Weber, Jr. Apr. 1972 25 p refs
(AD-740652; BRL-MR-2178) Avail: NTIS CSCL 14/2

Two different schemes for the laser doppler velocimeter are described and theoretically analyzed, a modified Mach-Zehnder velocimeter, and a modified Rayleigh velocimeter. Preliminary results obtained for the first scheme are shown and rather extensive results for the second scheme are presented. This latter method is shown to be capable under rather controlled conditions of obtaining speeds to well within 1%. Finally some results of a literature study concerning the use of laser doppler velocimetry as applied to the determination of the speed of wind tunnel flows are given. Author (GRA)

N72-30420# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SELECTION OF OPTIMUM EXPOSURE AND ITS AUTOMATIC ADJUSTMENT DURING AIR PHOTOGRAPHY
A. I. Sizov 11 Feb. 1972 13 p refs Transl. into ENGLISH from ZH. Nauchn. i Prikl. Fotogr. i Kinematogr. (Moscow), v. 15, no. 6, 1970 p 401-405
(AF Proj. 6220)
(AD-740196; FTD-MT-24-1598-71) Avail: NTIS CSCL 14/5

Consideration is shown of an approach to light sensitivity criteria from the standpoint of the selection of an exposure which makes it possible to obtain the maximum number of fine details on an aerial photo. A number of methods of programmed and automatic exposure control are considered, and estimates are made of their errors. Among the methods considered are a method of control according to integral brightness, a method of control according to minimum brightness, an integral method involving the selection of a video brightness signal according to the signal level, and an integral method involving the selection of a video brightness signal according to the level of the brightness coefficient. Author (GRA)

N72-30421# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING LIGHT DISTRIBUTION IN THE FOCAL PLANE OF SMALL-FORMAT AFA-MIIGAIK AERIAL CAMERAS
V. E. Permitin 3 Feb. 1972 14 p refs Transl. into ENGLISH

from Geodez. i Kartograf. (Moscow), no. 1, 1970 p 69-75
(AF Proj. 326E)
(AD-741494; FTD-MT-24-1127-71) Avail: NTIS CSCL 14/5

Problems are studied associated with the distribution of light in the focal plane of small format AFA-MIIGAiK (Aerial Camera Moscow Institute of Engineers of Geodesy, Aerial Surveying and Cartography) aerial cameras. The author makes recommendations on the basis of the results obtained from the study which contribute towards the more effective use of small format equipment and correct exponometric calculation and photographic processing of aerial photographs. Author (GRA)

N72-30422# Human Resources Research Organization, Alexandria, Va.
STUDIES ON REDUCED-SCALE RANGING TRAINING WITH A SIMPLE RANGE FINDER
Michael R. McCluskey Dec. 1971 35 p refs
(Contract DAHC19-70-C-0012; DA Proj. 2Q0-62107-A-712)
(AD-740163; HUMRRO-TR-71-24) Avail: NTIS CSCL 17/8

Three experiments of reduced-scale stadimetric ranging training were conducted for a criterion range of 1500 meters. The observers for all studies were trained in a reduced-scale (1/48) environment with stadimetric or occlusion ranging aids. Two of the studies also included a full-scale performance test with jet aircraft. The ranging training method consisted primarily of immediate feedback that contained either qualitative or quantitive information. The results of these studies are discussed. Author (GRA)

N72-30423# Massachusetts Univ., Amherst. Astronomy Research Facility.
HADAMARD, TRANSFORM SPECTROMETER Final Report, 1 Jul. 1970 - 30 Sep. 1971
John Strong Jan. 1972 34 p refs
(Contract F19628-70-C-0296; ARPA Order 1366; AF Proj. 8692)
(AD-740585; UMASS-ARF-72-268; AFCRL-72-0085) Avail: NTIS CSCL 04/1

A Hadamard Transform Spectrometer is described. This multiplexing spectrometer is based on a 127 square cyclic Hadamard matrix. A resolving power of 0.1/cm is achieved with a multiplexing gain factor of over five-fold in signal-to-noise ratio over use of a conventional single exit slit. A procedure for calibrating an infrared prism spectrometer plots drum numbers and wavelengths as ordinates against a trigonometric function of the index of the prism, as parameter and abscissae. The calibration data yields a straight line so only calibration data for two wavelengths is necessary. Author (GRA)

N72-30329 General Aniline and Film Corp., Binghamton, N.Y.
GAF COLOR FILMS FOR SPECIAL REMOTE SENSING APPLICATIONS
Ira B. Current *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 173-193 refs (For availability see N72-30319 21-13)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication; friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-30424*# Massachusetts Inst. of Tech., Cambridge.
DESIGN AND CONTROL OF REMOTE MANIPULATORS Quarterly Report, 5 Apr. - 4 Jul. 1972
Daniel E. Whitney 4 Jul. 1972 48 p
(Contract NAS8-28055)
(NASA-CR-123795; QR-2) Avail: NTIS HC $4.50 CSCL 13I

Results of investigations on vibrational modes of manipulators revealed: (1) any arbitrary manipulator may be analyzed for its small motion compliances; (2) a simulation of the Martin-Marietta shuttle boom with a 65,000 lb. payload attached, indicated three natural frequencies; and (3) simulations can be made of rigid limbs and flexible joints as well as for flexible limbs and locked joints and combinations thereof. Trajectories for arms were determined so that some integral criterion such as integral of kinetic energy or control torque magnitude is minimized over a motion of the arm. Experiments performed to evaluate various TV displays in conjunction with manipulator control modes showed that when mounted directly to the manipulator control arm and arranged to look approximately along the arm to the hand the operator could perform the task almost as quickly as when viewing the task directly. Author

N72-30425*# Carleton Controls Corp., East Aurora, N.Y.
SOLENOID VALVE, TYPE 1, NASA P/N 20M32258-1 (CARLETON P/N 2426-0001-1) Summary Report
M. L. Baczkowski Jun. 1972 40 p
(Contract NAS8-26348)
(NASA-CR-123790; CR-150) Avail: NTIS HC $4.00 CSCL 13K

The design, development, and evaluation of a solenoid valve assembly are discussed. The valve is a two-way, normally closed configuration for use as a control element in the metabolic analyzer of biomedical experiments during Skylab missions. Author

N72-30426*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
CONTAMINATION AVOIDANCE DEVICES FOR POPPET TYPE SHUTOFF VALVES Quarterly Report, 1 Mar. - 30 May 1972
D. L. Endicott 15 Jun. 1972 56 p
(Contract NAS3-14375)
(MDC-G3118; NASA-CR-127346; QPR-4) Avail: NTIS HC $5.00 CSCL 13K

The technology required to provide acceptable contamination damage avoidance characteristics for poppet type shutoff valves is discussed. Evaluation of the contamination avoidance characteristics of the basic 1T32095 propellant shutoff valve, the cycle life performance of these valves in an uncontaminated environment, and the effectiveness of various auxiliary contamination avoidance devices when used in conjunction with these poppet type valves are included. In addition, a secondary objective is to evaluate two methods of monitoring the performance of the test valves during actual operations using acoustical monitoring instrumentation. Author

N72-30427*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF ALLOYING ELEMENTS ON FRICTION AND WEAR OF COPPER
Donald H. Buckley Washington Sep. 1972 14 p refs
(NASA-TN-D-6912; E-6949) Avail: NTIS HC $3.00 CSCL 11F

The friction and wear characteristics were determined for copper binary alloys containing 10 atomic percent aluminum, silicon, indium, and tin. A ternary alloy containing 10 atomic percent aluminum and 5 atomic percent silicon was also examined. The effectiveness of each of the alloying elements aluminum and silicon were very effective in reducing friction. Silicon, however, also reduced wear appreciably. With lubrication, silicon, indium, and tin were all effective alloying elements in reducing friction and wear from values obtained for copper. Silicon was the most effective single element in reducing friction and wear in dry sliding and with lubrication. Author

N72-30428*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BOUNDARY LUBRICATION OF FORMULATED C-ETHER

IN AIR TO 300 DEG C. 1: PHOSPHORUS ESTER ADDITIVES
William R. Jones, Jr. and William F. Hady Washington Sep. 1972 19 p refs
(NASA-TN-D-6915; E-6682) Avail: NTIS HC $3.00 CSCL 11H

Friction and wear measurements were made on CVM M-50 steel lubricated with three C-ether (modified polyphenyl ether) formulations in dry and wet air. Results were compared to those obtained with a formulated Type 2 ester and the C-ether base fluid. A ball-on-disk sliding friction apparatus was used. Experimental conditions were a 1-kilogram load, a 17-meter-per-minute (100-rpm) surface speed, and a 25 to 300 C (77 to 572 F) disk temperature range. The C-ether base fluid and the three formulated C-ether fluids yielded lower wear than the Type 2 ester over the entire temperature range. All C-ether fluids exhibited slightly higher friction coefficients than the ester from 150 to 300 C (302 to 572 F) and similar values from 25 to 150 C (77 to 302 F). In general, lower wear rates were observed with the C-ethers when tested in wet air as compared to a dry air atmosphere. Author

N72-30429*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF POLARITY OF ELECTRIC CURRENT ON FRICTION BEHAVIOR OF TWO GALLIUM-LUBRICATED TANTALUM SLIPRING ASSEMBLIES
John Przybyszewski Washington Sep. 1972 27 p refs
(NASA-TN-D-6969; E-6974) Avail: NTIS HC $3.00 CSCL 11H

Computer-processed data from low-speed (10 rpm) slipring experiments with two similar (but of opposite polarity) gallium-lubricated tantalum slipring assemblies (hemisphere against disk) carrying 50 amperes dc in vacuum (10 to the minus 9th power torr) showed that the slipring assembly with the anodic hemisphere had significantly lower peak-to-peak values and standard deviations of coefficient-of-friction samples (a measure of smoothness of operation) than the slipring assembly with the cathodic hemisphere. Similar data from an experiment with the same slipring assemblies running currentless showed more random differences in the frictional behavior between the two assemblies. Author

N72-30430*# Mobil Research and Development Corp., Paulsboro, N.J.
MICROFOG LUBRICANT APPLICATION SYSTEM FOR ADVANCED TURBINE ENGINE COMPONENTS, PHASE 2. TASKS 3, 4, 5: WETTABILITY AND HEAT TRANSFER OF MICROFOG JETS IMPINGING ON A HEATED ROTATING DISC, AND EVALUATION OF RECLASSIFYING NOZZLES AND A VORTEX MIST GENERATOR
J. Shim and S. J. Leonardi 31 Aug. 1971 207 p refs
(Contract NAS3-13207)
(NASA-CR-120843) Avail: NTIS HC $12.50 CSCL 11H

The wettabilities and heat transfer rates of microfog jets (oil-mist nozzle flows) impinging on a heated rotating disk were determined under an inert atmosphere of nitrogen at temperatures ranging from 600 to 800 F (589 to 700 K). The results are discussed in relation to the various factors involved in the microfog lubricant application systems. Two novel reclassifying nozzles and a vortex mist generator were also studied. Author

N72-30431# Joint Publications Research Service, Arlington, Va.
THE AUTOMATED INDUSTRY OF CONTROL
D. Zhimerin 1 Aug. 1972 17 p Transl. into ENGLISH from Nauka i Zhizn. (Moscow), no. 6, 1972 16 p
(JPRS-56651) Avail: NTIS HC $3.00

The control of economic and social processes by a nationwide automated system to collect and process information for accounting, planning, and controlling the national economy of the U.S.S.R. is discussed. The system is built on the basis of a state system of computer centers and the unified automatic communications network. Author

N72-30432*# General Electric Co., Binghamton, N.Y. Aircraft Equipment Div.
HIGH TORQUE CMG ROTARY ACTUATOR Final Report
Jun. 1972 103 p
(Contract NAS5-20298)
(NASA-CR-122458; ACS-10357) Avail: NTIS HC $7.25 CSCL 13I

A high torque rotary actuator was designed, fabricated and tested. Exacting requirements were placed on performance and physical characteristics of the actuator, particularly in the area of stiffness, backlash, torque ripple, power and size and weight. A brushless dc motor was designed utilizing rare earth magnets to meet power and weight requirements. A 26-to-1 planetary roller gear transmission was selected to best meet overall requirements. The transmission utilizes parallel gear and roller paths to minimize backlash and breakaway torque. Author

N72-30433# Sandia Labs., Albuquerque, N.Mex.
FABRICATION OF FILAMENT REINFORCED METALS BY HOT ROLL BONDING
M. Moss, W. L. Cyrus, and C. B. Haizlip Feb. 1972 23 p refs Sponsored by AEC
(SC-DR-720117) Avail: NTIS

The major difficulty encountered in compacting metal-matrix composites of other than flat geometry is that the filaments are sometimes required to deform a large amount. Substantial deformation, such as would be required to consolidate thick sections, can result in kinking or breakage which could render the filaments useless as reinforcing agents. A fabrication method is described in this report in which a simultaneous heating and rolling operation forces matrix metal between the filaments, one filament layer at a time, thereby minimizing their movement. The result is a composite of desirable mechanical properties. Author

N72-30434# Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
ENVIRONMENT-SENSITIVE HARDNESS OF NON-METALS
Albert R. C. Westwood and Norman H. Macmillan Apr. 1972 88 p refs
(Contract N00014-70-C-0330; NR Proj. 032-524)
(AD-742462; RIAS-72-08C) Avail: NTIS CSCL 13/8

Current understanding of the mechanisms by which non-corrosive chemical environments influence the near-surface flow behavior, and hence microhardness, of crystalline non-metals and silicate glasses is described, and new data is presented showing how these effects may be applied to such technologically important areas as the machining of ceramics and drilling of rocks. In particular, it is demonstrated that, by appropriate choice of cutting environment, silicate glasses may be drilled twenty times faster than in water. Corresponding fourteen-, seven-, and three-fold increases in drilling rate are also reported for quartz, alumina and granite respectively. Attention is drawn especially to the significant role of surface charge in determining microhardness and machinability, and to the importance of considering the total system of solid - tool (mode of cutting) environment in any application of environment-facilitated machining. Author (GRA)

N72-30435# Army Weapons Command, Rock Island, Ill. Weapons Lab.
A SURVEY OF SOLID LUBRICANT TECHNOLOGY
Peter Martin, Jr. Mar. 1972 30 p refs
(DA Proj. 1W5-62604-A-621)
(AD-741764; SWERR-TR-72-9) Avail: NTIS CSCL 11/8

New developments in the areas of solid lubricant powders, bonded films, and self-lubricating composites are reviewed along with new application techniques. Recently synthesized lubricant solids include sulfides, selenides and tellurides of heavy metals. Some of these new materials have provided lower friction coefficients, greater oxidation stability, and chemical stability. Bonded solid film lubricants have been improved by use of polyimides, polybenzimidazoles, and polybenzothiazoles. The use of inorganic binders of silicates, phosphates, and fluorides is

discussed. New techniques for applying solid lubricants include plasma spraying, electrophoresis, electrodeposition, vacuum deposition, and ion plating. Self-lubricating composites, recently developed, are of the metal-plastic-based types. GRA

N72-30436# Defense Documentation Center, Alexandria, Va.
EMBRITTLEMENT Report Bibliography, Mar. 1963 - Sep. 1971
May 1972 141 p refs
(AD-742000; DDC-TAS-72-21-I) Avail: NTIS CSCL 13/8

References in the bibliography cover such topics as: embrittlement of metals by organic liquids, embrittlement of high-strength steel and aluminum in the presence of water, alcohols, glycols, ethers, and aldehydes, embrittlement of polycrystalline silver chloride, investigation of thermal embrittlement in managing steel, liquid metal embrittlement, stress-relief embrittlement of HY-130(T) weld metals and effect of embrittled 110-18 weld metal on the fatigue life of HY-80 steel butt weldments, etc. Corporate Author-Monitoring Agency, Subject, Title, Contract, and Report Number Indexes are included.
Author (GRA)

N72-30437# Tennessee Univ., Knoxville. Dept. of Engineering Mechanics.
AN INVESTIGATION OF THE DRAG FORCES ON A SHAFT ROTATING CONCENTRICALLY IN A POROUS CYLINDER WITH FLUID INJECTION OR SUCTION M.S. Thesis
Bobby J. Gaines Mar. 1972 57 p refs
(Contract N00014-68-A-0144)
(AD-740832; EM-72-2) Avail: NTIS CSCL 13/9

The equations of motion for steady incompressible flow in an annulus with fluid removal or injection at the porous walls have been reduced to a pair of ordinary differential equations by Terrill. The sclution of the related problem of a plane channel with a moving wall can be expressed in terms of the corresponding results for a stationary wall. That solution is obtained in the present work. The solution is used to determine the drag on the moving wall. Preliminary experimental results with an apparatus consisting of a porous outer cylinder and a solid rotating shaft indicate satisfactory agreement with the theoretical calculations for the case of fluid injection. Author (GRA)

N72-30438# Mechanical Technology, Inc., Latham, N.Y.
APPLICATION OF NEW AND IMPROVED SOLID LUBRICANT MATERIALS AND PROCESSES TO NAVAL AIRCRAFT. EMPHASIZING REDUCED MAINTENANCE AND IMPROVED RELIABILITY
M. B. Peterson and E. F. Finkin 14 Jul. 1971 145 p refs
(Contract N62269-71-C-0177)
(AD-740825; MTI-71TR48) Avail: NTIS CSCL 11/8

The overall objective of the program was to help to extend the aircraft operating interval between rework and maintenance actions and savings of aircraft rework hours. The program goal was to improve the performance of current solid lubricant materials and processes, via several ways: Substitution of new and improved materials and processes, introduction of solid lubricants to new applications where they could be advantageously used, and simplification or elimination of unneeded processing steps. Formal recommendations were formulated and are contained in this report. Author (GRA)

N72-30439# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF RF SPUTTER ETCHING IN AN ARGON PLASMA USING SILICON AS A TARGET M.S. Thesis
William G. Duke Mar. 1972 125 p refs
(AD-742436; GE/EE/72-10) Avail: NTIS CSCL 13/8

Highly reproducible etch rates were achieved by sputter etching on silicon and aluminum targets in an RF generated argon plasma. The target materials were subjected to a number of different etching conditions to evaluate the dependence of etch rate upon electrode separation, argon pressure, self-biasing voltage, and a static magnetic field. Formulas for etch rate dependence upon the self-bias boltage and magnetic field were derived from theoretical considerations and experimental observations. Plasma contamination and masking technique were critical factors. With the proper selection of etching conditions, etch rates were reproduced with an error less than 5%. Author (GRA)

N72-30440# Kansas State Univ., Manhattan. Dept. of Physics.
SINGLE SOURCE TECHNIQUES FOR THE EVAPORATION OF ALLOY FILMS. STEADY STATE EVAPORATION OF InSb ALLOYS Annual Report, Apr. 1966 - Oct. 1967
E. Brock Dale Mar. 1971 62 p refs
(Contract DA-49-186-AMC-345(x); DA Proj. 1B2-62301-A-300; HDL Proj. CMT96)
(AD-741336; HDL-345-1; AR-1) Avail: NTIS CSCL 13/8

A procedure is described that allows the evaporation, from a single source containing starting mixture or alloy of given composition, a vapor mixture having the same composition as the starting mixture. The procedure is referred to as steady-state evaporation. The theory of steady-state evaporation is presented for several sets of source conditions, and some numerical examples are given. Details of the experimental evaluation of the procedure are given. InSb is used as a test material because of the high vapor-pressure ratio of the components. Techniques for the analysis of films by X-ray fluorescence are described. GRA

N72-30441# Defense Documentation Center, Alexandria, Va.
ENCAPSULATION Report Bibliography, Oct. 1955 - Sep. 1971
May 1972 115 p refs
(AD-740990; DDC-TAS-72-19-1) Avail: NTIS

Encapsulation used as a protective covering for electronic circuits, insulation from moisture and heat, and lacquer film and thin film coatings of capacitors, is the subject of the bibliography. References dealing with failures, cracks, and deterioration effects are amply represented. Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes are included.
Author (GRA)

N72-30442# Kansas State Univ., Manhattan. Dept. of Physics.
SINGLE SOURCE TECHNIQUES FOR THE EVAPORATION OF ALLOY FILMS. STEADY STATE EVAPORATION OF InSb AND Bi-Sb ALLOYS Final Report, Apr. 1966 - Oct. 1968
E. Brock Dale Washington, D. C. Harry Diamond Labs. Mar. 1971 51 p
(Contract DA-49-186-AMC-345(X); DA Proj. 1B2-62301-A-300)
(AD-741337; HDL-345-2) Avail: NTIS CSCL 13/8

A procedure is described that allows the evaporation, from a single source containing starting mixture or alloy of given composition, a vapor mixture having the same composition as the starting mixture. The procedure is referred to as steady-state evaporation. Details of the experimental evaluation of the procedure are given. In Sb and Bi-Sb alloys are used as test mixtures because they represent extremes of relative volatility of the components. The theory is briefly summarized. Techniques for the analysis of films by X-ray fluorescence are described in detail. Author (GRA)

N72-30443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-ALIGNING SLIDE BEARINGS
A. K. Sidelnikov 24 Jan 1972 10 p Transl. into English from Tekhnol. Organ. Proizvod. (Kiev), no. 3, 1970 p 93-95
(AF Proj. 7343)
(AD-741490; FTD-HT-23-1264-71) Avail: NTIS CSCL 13/9

The article contains a study of the method of planning and designing self adjusting slide bearings in which the minimum frictional moment of the bearing is insured along the shaft with maximum possible calculated radial load on the bearing. This is

achieved by decreasing the angle alpha (half the angle of the hollow centering cone) to a value insuring self braking of the ball in which the slide bearing is executed. High accuracy of centering the ball is insured in this case. A brief description of the structural design of the bearings is presented. Author (GRA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-30444*# Isomet Corp., Oakland, N.J.
DYNAMIC HOLOGRAPHIC STORAGE IN LITHIUM NIOBATE Final Report
Harmon Aronson May 1972 45 p refs
(Contract NAS8-26635)
(NASA-CR-123770) Avail: NTIS HC $4.25 CSCL 20E

A program was undertaken to improve the optical recording properties of LiNbO3 for holographic optical memory application. Iron, copper, and manganese doping were all found to increase the optical sensitivity of LiNbO3. Over two orders of magnitude improvement was obtained, resulting in an exposure of 366 wirojoule/sq mm to obtain 1% efficiency in LiNbO3:Fe. High :Fe. High quality pictorial information was stored in 1mm diameter holograms. Author

N72-30445*# Texas Univ., Austin.
LUNAR LASER RANGING DATA DEPOSITED IN THE NATIONAL SPACE SCIENCE DATA CENTER: FILTERED OBSERVATIONS FOR SEPTEMBER 1969 THROUGH JUNE 1970 AND UNFILTERED PHOTON DETECTIONS FOR JULY THROUGH DECEMBER 1970
J. Derral Mulholland, Peter J. Shelus, and Karen Terrell Jan. 1972 8 p refs
(Grant NGR-44-012-219)
(NASA-CR-127348; RM-72-003) Avail: NTIS HC $3.00 CSCL 20E

The technique of laser ranging to a reflector fixed on the lunar surface is discussed. The causes for initial low rate of data acquisition are explained. The documentation to be used in conjunction with the deposition of the filtered data in the National Space Science Data Center are documented. Filtered data obtained during laser operations between the McDonald Observatory and the reflector at Tranquility Base during the interval September 1969 through June 1970 are presented. The unfiltered photon detections for the succeeding six months are examined. Author

N72-30446*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF SPEED OF RESPONSE OF HIGH-SPEED VISIBLE AND IR OPTICAL DETECTORS
H. Edward Rowe and John S. Osmundson Washington Aug. 1972 14 p refs
(NASA-TN-D-6874; G-1074) Avail: NTIS HC $3.00 CSCL 20F

A technique for measuring speed of response of high speed visible and IR optical detectors to mode-locked Nd:YAG laser pulses is described. Results of measurements of response times of four detectors are presented. Three detectors that can be used as receivers in a 500-MHz optical communication system are tested. Author

N72-30447# Joint Publications Research Service, Arlington, Va.
A LASER OPTICAL LINK ASSEMBLY
V. V. Nikitin and V. D. Samoylov 17 Aug. 1972 10 p refs
Transl. into ENGLISH from Kvantovaya Elektron. (USSR), no. 3, 1971 p 23-28
(JPRS-56804) Avail: NTIS HC $3.00

Results of research on the laser optron (electronic-optical, link assembly) which consists of a nonhomogeneously excited injection laser and a photodiode are given. It is demonstrated that such an optron is an optical transistor with an amplification factor with respect to radiation power of 100, and that it can be employed in high-speed devices for handling information optically. Author

N72-30448# Sandia Labs., Albuquerque, N.Mex.
NEUTRON IRRADIATION EFFECTS ON DIFFUSED GaAs LASER DIODES
B. W. Noel (N. Mex. Univ., Albuquerque), C. E. Barnes, and H. D. Southward (N. Mex. Univ., Albuquerque) [1971] 9 p refs Sponsored by AEC, ONR, and HEW
(SC-R-722618) Avail: AEC Depository Library

The effects of fast neutron damage on diffused GaAs laser diodes were studied by observing the pre- and post-irradiation current-voltage characteristics and electroluminescence spectra at several temperatures between 75 K and 300 K. The pre-irradiation diode current at high temperature is dominated by nonradiative space-charge region recombination. The principal emission band at 300 K results from band-to-acceptor recombination in the p-region. A secondary band at 1.28 eV occurs via donar-acceptor pair recombination in the depletion region. At low temperature, the dominant diode current flow is by nonradiative tunneling while the principal emission band contains radiative tunneling and bandfilling components. Neutron irradiation increases the constant-voltage diode current. The additional current is due to space-charge region recombination (SC) at high temperatures and both SC and tunneling at low temperatures. Author (NSA)

N72-30449# Institut Franco-Allemand de Recherches, St. Louis (France).
FOG METROLOGY BY HOLOGRAPHY [METROLOGIE DES BROUILLARDS PAR HOLOGRAPHIE]
H. Royer 29 May 1972 17 p refs In FRENCH Presented at the meeting on Appl. des Lasers a la Metrologie et au Domaine Aerospatial, 21 Jun. 1972; sponsored by Soc. des Electriciens et Electroniciens
(ISL-NB-1/72) Avail: NTIS HC $3.00

Holographic techniques were applied to the counting and measurement of moving fog droplets to predict their effect on aircraft engine operation. Some problems encountered during the image restoration of phase objects are presented. A solution is proposed and it is concluded that holography is suitable for local fog measurements of droplet diameter and concentration. ESRO

N72-30450# Naval Weapons Center, China Lake, Calif. Systems Development Dept.
FREQUENCY AGILE LASER TECHNIQUES
Michael K. Giles and R. S. Hughes Mar. 1972 44 p refs
(AD-742082; NWC-TP-5336) Avail: NTIS CSCL 20/5

Three rapidly tunable organic dye lasers have been developed and evaluated in an effort to produce a frequency agile laser with optimum beam properties. The basic design of each system comprises a pulsed nitrogen gas laser optical pump source, a 0.001 M rhodamine 6 G/ethanol active medium, and an optical resonant cavity with an intracavity tuning device that rapidly changes the wavelength of narrow-band stable oscillation. Their difference lies in the type of intracavity tuning device employed. One system is operated with a galvanometer-driver optical scanner, another with an optical scanner driven by piezoelectric bimorph strips, and the third with a rapid scanning Fabry-Perot interferometer. Author (GRA)

N72-30451# Naval Training Device Center, Orlando, Fla.
SEMICONDUCTOR LASER WEAPON FIRE SIMULATORS FOR POP-UP AND AERIAL TARGET ENGAGEMENT TRAINING
Albert H. Marshall and George A. Siragusa Mar. 1972 28 p
(NAVTRADEVCEN Proj. 1714-05)
(AD-742084; NAVTRADEVCEN-IH-189;

NAVTRADEVCEN-7881-56) Avail: NTIS CSCL 20/5

The technical report describes two weapon fire simulation systems for military training in pop-up and aerial target engagement. These systems both utilize gallium arsenide lasers.

Author (GRA)

N72-30452# Naval Research Lab., Washington, D.C.

X-RAY AND VACUUM UV LASERS: CURRENT STATUS AND PROGNOSIS Interim Report

Raymound C. Elton, Ronald W. Waynant, Ronald A. Andrews, and Michael H. Reilly 2 May 1972 28 p refs

(AD-742073; NRL-7412) Avail: NTIS CSCL 20/5

The amplification of X-radiation by stimulated emission appears to be nearing the point of being experimentally feasible. This report analyzes the theoretical foundations for an X-ray laser by means of a generalized rate equation approach and determines the general requirements to be placed on the pumping rate, its rate of rise, and on excited-state lifetimes. These requirements give a basis for a selection and optimization of promising excitation (pumping) techniques and possible lasing media. In addition, most of the previous literature relevant to X-ray lasers have been reviewed and evaluated to assess its likely future application in the development of a realistic X-ray laser.

Author (GRA)

N72-30453# RAND Corp., Santa Monica, Calif.

OPTICAL DISTORTION BY HEATED WINDOWS IN HIGH-POWER LASER SYSTEMS

Marshall Sparks Sep. 1971 60 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(AD-742244; R-545-PR) Avail: NTIS CSCL 20/5

The optical distortion of a laser beam by a heated window in a typical long-focal-length system can significantly reduce the beam intensity at the target at power levels less than those required to melt or fracture the window. The spatially inhomogeneous incident laser intensity causes a temperature gradient which produces nonuniform changes in the thickness and the index of refraction of the window, causing it to become a lens having aberration and birefringence in addition to a finite focal length. Expressions are derived for the thermally induced optical distortion in terms of measurable parameters such as the index of refraction, the strain-optical coefficients, and the thermal expansion coefficient. Since not all the values of these parameters are known for most materials of interest, alternative expressions are derived for use in obtaining rough estimates of the amount of distortion.

Author (GRA)

N72-30454# Harry Diamond Labs., Washington, D.C.

FIELD TEST OF A LASER SIGNALLING DEVICE

Thomas J. Gleason, Robert M. Curnutt, John S. Kruger, Robert T. Maupin, and Colin S. Willett Mar. 1972 25 p refs

(DA Proj. 1T0-61102-A-31C)

(AD-741787; HDL-TM-72-7) Avail: NTIS CSCL 17/7

The report describes a test, under realistic field conditions, of the feasibility of using a small helium-neon gas laser as a visible signalling beacon. A 1.5-milliwatt laser beam with 2-milliradian beam divergence was clearly visible from the air at a slant range of 30 kilometers, against a bright sunlit background of river, forest, and marshland. The required aiming precision, optimum beam divergence, and narrow-beam secure nature of the laser beacon are discussed. The eye-hazard involved in the use of a laser signaller is shown to be quite small and probably controllable in a field environment. A prototype device that meets the requirement for a compact, light-weight, and self-contained long-range visible beacon is described.

Author (GRA)

N72-30455# Army Missile Command, Redstone Arsenal, Ala. Physical Sciences Directorate.

CONTINUOUS WAVE CHEMICAL LASER MODELING ASSUMING INSTANTANEOUS MIXING

T. G. Roberts, W. A. Friday, D. W. Howgate, and T. A. Barr, Jr. 31 Dec. 1971 48 p refs

(DA Proj. 1T6-62705-A-308)

(AD-741335; RR-TR-72-6) Avail: NTIS CSCL 20/5

The results of a theoretical effort to develop models which will be useful in the experimental program to study certain chemical lasers are presented in the report. A simple model of a flowing continuous wave chemical laser assuming instantaneous mixing is developed and used to treat the Cl - HBr reaction as an illustrative example. A nozzle exit and cavity program which was developed to treat gas dynamic lasers is to be used to modify the model studied for transfer chemical lasers. The results obtained using this program to make numerical calculations of the performance of the arc-driven supersonic mixing laser operating in the gas dynamic mode are compared with experimental results. A theoretical model of the CS2 + 02 flame O2 flame laser has been set up.

Author (GRA)

N72-30456# Army Missile Command, Redstone Arsenal, Ala. Physical Sciences Directorate.

PULSED LASER EMISSION FROM DISSOCIATIVELY PRODUCED N, C, Cl, AND F ATOMS

James R. English, Hugh C. Gardner, and James A. Merritt 23 Feb. 1972 23 p refs

(DA Proj. 1T6-62705-A-308)

(AD-741334; RR-TR-72-5) Avail: NTIS CSCL 20/5

Laser emission from atomic nitrogen at 1.3583 micrometers, carbon at 1.4543 micrometers, chlorine at 1.5871 micrometers and 2.4466 micrometers, and fluorine at 0.7131 micrometers and 0.7041 micrometers has been observed in a pulsed electrical discharge through flowing mixtures of a parent compound (N2, NO, N2O, NO2, ClNO, NH3, NF3, CO, CO2, OCS, CS2, C2H2, C2H5OH, or CCl4) and helium. The emission appeared as one or more peaks at each wavelength. In many cases the number of peaks in the laser signal depended on the pulse repetition rate, peak current, and the parent-compound-to-helium pressure ratio.

Author (GRA)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N72-30457*# Western Applied Research and Development, Inc., San Carlos, Calif.

MATERIALS DATA HANDBOOK: ALUMINUM ALLOY 5456

R. F. Muraca and J. S. Whittick Jun. 1972 102 p refs

(Contract NAS8-26644)

(NASA-CR-123827) Avail: NTIS HC $7.25 CSCL 11F

A summary of the materials property information for aluminum alloy 5456 is presented. The scope of the information includes physical and mechanical property data at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques is developed. Author

N72-30458*# Western Applied Research and Development, Inc., San Carlos, Calif.

MATERIALS DATA HANDBOOK: ALUMINUM ALLOY 6061

R. F. Muraca and J. S. Whittick May 1972 114 p refs Revised

(Contract NAS8-26644)

(NASA-CR-123772) Avail: NTIS HC $7.75 CSCL 11F

A summary of the materials property information for aluminum alloy 6061 is presented. The scope of the information includes physical and mechanical properties of the alloy at

cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy, corrosion, environmental effects, fabrication, and joining techniques is developed. Author

N72-30459*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK: ALUMINUM ALLOY 7075
R. F. Muraca and J. S. Whittick Apr. 1972 141 p refs Revised
(Contract NAS8-26644)
(NASA-CR-123773) Avail: NTIS HC $9.25 CSCL 11F

A summary of the materials property information on aluminum alloy 7075 is presented. The scope of the information includes physical and mechanical properties of the alloy at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy, corrosion, environmental effects, fabrication, and joining techniques is developed. Author

N72-30460*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK: INCONEL ALLOY 718
R. F. Muraca and J. S. Whittick Apr. 1972 115 p refs
(Contract NAS8-26644)
(NASA-CR-123774) Avail: NTIS HC $7.75 CSCL 11F

A summary of the materials property information for Inconel alloy 718 is presented. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques is developed. Author

N72-30461*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK: ALUMINUM ALLOY 2219
R. F. Muraca and J. S. Whittick Mar. 1972 149 p refs
(Contract NAS8-26644)
(NASA-CR-123777) Avail: NTIS HC $9.50 CSCL 11F

A summary of the materials property information for aluminum 2219 alloy is presented. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques is developed. Author

N72-30462*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK: STAINLESS STEEL TYPE 301
R. F. Muraca and J. S. Whittick Apr. 1972 106 p refs
(Contract NAS8-26644)
(NASA-CR-123780) Avail: NTIS HC $7.50 CSCL 11F

A summary of the materials property information for stainless steel type 301 is presented. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and bonding is developed. Author

N72-30463*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK: STAINLESS STEEL ALLOY A-286
R. F. Muraca and J. S. Whittick Jun. 1972 109 p refs
(Contract NAS8-26644)
(NASA-CR-123776) Avail: NTIS HC $7.50 CSCL 11F

A summary of the materials property information for stainless steel alloy A-286 is presented. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and bonding is developed. Author

N72-30464*# Western Applied Research and Development, Inc., San Carlos, Calif.
MATERIALS DATA HANDBOOK. TITANIUM 6AI-4V
R. F. Muraca and J. S. Whittick May 1972 124 p refs
(Contract NAS8-26644)
(NASA-CR-123775) Avail: NTIS HC $8.25 CSCL 11F

A summary of the materials property information for Titanium 6AI-4V alloy is presented. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures. Information on material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and bonding is developed. Author

N72-30465*# Montana Coll. of Mineral Science and Technology, Butte.
A METALLOGRAPHIC EVALUATION OF SOME COATED COLUMBIUM ALLOYS
V. Griffiths Jan. 1972 28 p
(Grant NGR-27-003-001)
(NASA-CR-127917) Avail: NTIS HC $3.50 CSCL 11F

The results of a metallographic study of two coated columbium shuttle candidate materials are presented. Optical and scanning electron microscopy examinations were conducted on coating R512E and VH109. Author

N72-30466*# Battelle Memorial Inst., Columbus, Ohio.
WELDING AND BRAZING OF NICKEL AND NICKEL-BASE ALLOYS
J. E. Mortland, R. M. Evans, and R. E. Monroe Washington NASA 1972 89 p refs
(Contract NASw-1842)
(NASA-SP-5101; LC-78-177267) Avail: NTIS; SOD $1.00 CSCL 11F

The joining of four types of nickel-base materials is described: (1) high-nickel, nonheat-treatable alloys, (2) solid-solution-hardening nickel-base alloys, (3) precipitation-hardening nickel-base alloys, and (4) dispersion-hardening nickel-base alloys. The high-nickel and solid-solution-hardening alloys are widely used in chemical containers and piping. These materials have excellent resistance to corrosion and oxidation, and retain useful strength at elevated temperatures. The precipitation-hardening alloys have good properties at elevated temperature. They are important in many aerospace applications. Dispersion-hardening nickel also is used for elevated-temperature service. Author

N72-30467# Joint Publications Research Service, Arlington, Va.
SILICON SYSTEMS ALLOYED WITH IRON, COBALT, AND NICKEL
P. V. Geld and F. A. Sidorenko 8 Aug. 1972 155 p Transl. into ENGLISH from the book "Silitsidy Perekhodnykh Metallov Chetvertogo Perioda" Moscow, Met. Publishing House, 21 May 1971 p 178-333
(JPRS-56710) Avail: NTIS HC $9.75

An analysis is presented of the physical characteristics of silicon systems alloyed with iron, cobalt, and nickel. Author

N72-30468*# Battelle Memorial Inst., Columbus, Ohio.
THE ALLOY WITH A MEMORY, 55-NITINOL: ITS PHYSICAL METALLURGY, PROPERTIES, AND APPLICATIONS Technology Utilization
C. M. Jackson, H. J. Wagner, and R. J. Wasilewski Washington NASA 1972 91 p refs Sponsored by NASA
(NASA-SP-5110; LC-74-177266) Avail: NTIS; SOD $1.00 CSCL 11F

A series of nickel titanium alloys (55-Nitinol), which are

unique in that they possess a shape memory, are described. Components made of these materials that are altered in their shapes by deformation under proper conditions return to predetermined shapes when they are heated to the proper temperature range. The shape memory, together with the force exerted and the ability of the material to do mechanical work as it returns to its predetermined shape, suggest a wide variety of industrial applications for the alloy. Also included are discussions of the physical metallurgy and the mechanical, physical, and chemical properties of 55-Nitinol; procedures for melting and processing the material into useful shapes; and a summary of applications. Author

N72-30469*# Hayes International Corp., Huntsville, Ala.
BANDING DUE TO TEMPERATURE OSCILLATIONS IN THE UNIDIRECTIONAL SOLIDIFICATION OF EUTECTIC ALLOYS
A. Kidron 1 Aug. 1972 13 p refs
(NASA-CR-61391; WD-551) Avail: NTIS HC $3.00 CSCL 11F

Banding observed in unidirectional solidification of eutectic alloys is shown to be due to melting back of the freezing interface because of oscillations in the temperature of the furnace. General theoretical criteria as to the amplitude and frequency of the permissible temperature oscillations are given to ensure that banding will not occur. Author

N72-30470*# Aerojet Solid Propulsion Co., Sacramento, Calif. Advanced Technology.
CORRELATION OF STRESS-WAVE-EMISSION CHARACTERISTICS WITH FRACTURE ALUMINUM ALLOYS Final Report
C. E. Hartbower, W. G. Reuter, C. F. Morais, and P. P. Crimmins Washington NASA Jul. 1972 233 p refs
(Contract NAS8-21405)
(NASA-CR-2072) Avail: NTIS HC $3.00 CSCL 11F

A study to correlate stress wave emission characteristics with fracture in welded and unwelded aluminum alloys tested at room and cryogenic temperature is reported. The stress wave emission characteristics investigated were those which serve to presage crack instability; viz., a marked increase in:(1) signal amplitude; (2) signal repetition rate; and (3) the slope of cumulative count plotted versus load. The alloys were 7075-T73, 2219-T87 and 2014-T651, welded with MIG and TIG using 2319 and 4043 filler wire. The testing was done with both unnotched and part-through-crack (PTC) tension specimens and with 18-in.-dia subscale pressure vessels. In the latter testing, a real time, acoustic emission, triangulation system was used to locate the source of each stress wave emission. With such a system, multiple emissions from a given location were correlated with defects found by conventional nondestructive inspection. Author

N72-30471*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVIEW OF STATUS AND POTENTIAL OF TUNGSTEN-WIRE: SUPERALLOY COMPOSITES FOR ADVANCED GAS TURBINE ENGINE BLADES
Robert A. Signorelli Washington Sep. 1972 23 p refs
(NASA-TM-X-2599; E-7020) Avail: NTIS HC $3.00 CSCL 11F

The current status of development of refractory-wire-superalloy composites and the potential for their application to turbine blades in land-based power generation and advanced aircraft engines are reviewed. The data indicate that refractory-wire-superalloy composites have application as turbine blades at temperatures of 2200 F and above. Author

N72-30472# Joint Publications Research Service, Arlington, Va.
PHYSICOCHEMICAL METHODS OF PHASE ANALYSIS OF STEELS AND ALLOYS
N. F. Lashko 11 Aug. 1972 94 p refs Transl. into ENGLISH from the book "Fiziko-Khimicheskiye Metody Fazovogo Analiza Staley i Splavov" Moscow, Metallurgy Publishing House, 1970
(JPRS-56746) Avail: NTIS HC $6.75

Methods of complex physicochemical phase analysis are systematized and generalized, including methods of phase separation and chemical and X-ray structure analysis of phases. Questions of the theory of electrochemical phase separation, the principles of selection of electrolytes and methods of phase analysis of various steels and alloys are examined. Author

N72-30473# Joint Publications Research Service, Arlington, Va.
THE EFFECT OF BORON ON THE STRUCTURE AND CERTAIN PROPERTIES OF ELECTRON BEAM MELTED MOLYBDENUM
V. S. Chernov, F. I. Busol, V. N. Lapitskaya, B. P. Nam, and G. I. Kreymerman 16 Aug. 1972 14 p refs Transl. into ENGLISH from Fiz. Metal. Metalloved. (Sverdlovsk), v. 33, no. 5, 1972 p 1008-1018
(JPRS-56785) Avail: NTIS

The influence of small quantities of boron on the structure and certain mechanical properties of cast and deformed electron beam melted molybdenum is studied. It is demonstrated that the boron has a strong modifying influence on the macrostructure, microstructure, and substructure of the metal, and facilitates refining of grain boundaries. Microalloying with boron leads to a significant increase in the ductility of molybdenum, as well as its strength and recrystallization temperature. Author

N72-30474*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF THE REACTION OF 5Al-2.5Sn TITANIUM WITH HYDROGEN AT SUBZERO TEMPERATURE Final Report, 24 Jun. 1971 - 15 Apr. 1972
D. N. Williams and R. A. Wood 15 May 1972 36 p refs
(Contract NAS9-12044)
(NASA-CR-128496) Avail: NTIS HC $4.00 CSCL 11F

An investigation of the effect of temperature on the surface hydriding reaction of 5Al-2.5Sn titanium exposed to hydrogen at 250 psig was made. The temperature range studied extended from 160 F to -160 F. Reaction conditions were controlled so as to expose a vacuum-cleaned, oxide-free alloy surface to an ultrapure hydrogen atmosphere. Reaction times up to 1458 hours were studied. The hydriding reaction was extremely sensitive to experimental variables and the reproducibility of reaction behavior was poor. However, it was demonstrated that the reaction proceeded quite rapidly at 160 F; as much as 1 mil surface hydriding being observed after exposure for 162 hours. The amount of hydriding appeared to decrease with decreasing temperature at 75 F, -36 F, and -76 F. No surface hydriding was detected either by vacuum fusion analysis or by metallographic examination after exposure for 1458 hours at -110 F or -160 F. Tensile properties were unaffected by surface hydriding of the severity developed in this program (up to 1 mil thick) as determined by slow strain rate testing of hydrided sheet tensile samples. Author

N72-30475# California Univ., Berkeley. Lawrence Berkeley Lab.
RELATIONSHIPS BETWEEN MICROSTRUCTURE AND FRACTURE TOUGHNESS IN A SECONDARY HARDENING STEEL
Roger D. Goolsby Nov. 1971 123 p refs
(Contract W-7405-eng-48)
(LBL-405) Avail: NTIS

The relationships between microstructure and fracture toughness in a 0.3% C, 5% Mo steel have been studied. The techniques of transmission electron microscopy, scanning electron microscopy, fracture toughness testing, and stress wave emission detection were used to characterize the structure. The microstructure of quenched and tempered structures consisted of a ferritic matrix containing a dispersed precipitate of Fe3C or Mo2C, depending on the tempering temperature. The plane strain fracture toughness showed a marked dependence on microstructure. It was found that sharp decreases in toughness were due to preferential precipitation of carbides on martensite laths boundaries. Because the steel studied was a secondary

hardening type steel, correlations could be made of microstructure and fracture toughness at similar yield strengths. Author

N72-30476# Sandia Labs., Albuquerque, N.Mex.
MECHANICAL PROPERTIES OF 6061-T6 ALUMINUM AFTER VERY RAPID HEATING
J. Lipkin, J. C. Swearengen, and C. H. Karnes Mar. 1972 100 p refs Sponsored by AEC
(SC-RR-720020) Avail: NTIS

The effects of time, temperature and strain rate on the yield strength determined at elevated temperature have been investigated for 6061-T6, -T651 aluminum alloy. To achieve very short times-at-temperature, nanosecond pulse heating produced by electron beam energy depostion was used along with one-dimensional stress wave loading. When a relatively thick sample is heated in this way it can not expand on the same time scale as the temperature increase. As a result, stress relief waves propagate in the material after energy deposition, and this deformation occurring at high strain rates and elevated temperatures produces microstructural changes that reduce the strength of the alloy on the time scale of a few micron sec. This strength reduction occurs in addition to that due to the lowered shear modulus at-temperature, and is an essentially permanent change reflected in the greatly reduced room temperature strength of the material following nanosecond pulse heating.
Author

N72-30477# Atomic Weapons Research Establishment, Aldermaston (England).
TENSILE PROPERTIES OF HOT PRESSED BERYLLIUM: EFFECT OF STRAIN RATE ON PROPERTIES UP TO 1100 K
G. I. Turner and E. G. King Jan. 1972 18 p refs
(AWRE-O-5-72) Avail: AEC Depository Libraries; UK 50p

For the strain rates .004, .0025, and .05 S sup -1 in 100% dense beryllium the variation of the ultimate tensile strength (UTS), fracture stress, and reduction of area with temperature, in the range 300 to 1100 K, are presented and analyzed. Within this temperature range both the UTS and the fracture stress were increased up to eight fold by raising the strain rate from .004 to .05 sub -1. For a constant strain rate a maximum was observed in the curve of reduction of area versus temperature. The effects of increasing the strain rate were to raise the temperature at which the maximum occurs and to slightly reduce the peak value of the reduction of area. The UTS and fracture stress were functions of the temperature compensated strain rate (TCS). The best fit value of the activation energy for both the UTS and fracture stress was approximately 41000 cal. It is proposed that the TCS characterizes the mode of failure and this premise is applied to the brittle/ductile transition. Author (NSA)

N72-30478# National Aerospace Lab., Amsterdam (Netherlands).
A REVIEW AND ANALYSIS OF FATIGUE CRACK PROPAGATION IN TITANIUM ALLOYS AT ROOM TEMPERATURE
R. J. H. Wanhill Feb. 1971 186 p refs Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-71035-U) Avail: NTIS HC $11.50

Fatigue crack propagation is reviewed to indicate how quantitative microscopic and macroscopic observations can be correlated with theories based on the fracture mechanics concept of the stress intensity factor. Available data for titanium alloys tested at room temperature were analysed using the fracture mechanics approach, and the results are presented both graphically and numerically. The data indicate that titanium alloys in general are susceptible to corrosion fatigue in aqueous environments and that a material immune to static stress corrosion may be susceptible to corrosion fatigue. It is considered that the data are too limited. The majority of data compiled refer to Ti-8A1-1Mo-IV, which is no longer considered for extensive deployment, because of its extreme susceptibility to hot salt and seawater stress corrosion. Author (ESRO)

N72-30479# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
TESTS ON THE SOURCE OF ANOMALOUS RESIDUAL STRESSES OBTAINED BY X-RAY DIFFRACTION TECHNIQUES
Robert H. Marion and Jerome B. Cohen 30 Dec. 1971 48 p refs
(Contract N00014-67-A-0356-0008)
(AD-741711; TR-4) Avail: NTIS CSCL 11/6

The magnitude and origin of residual stresses after uniaxial plastic deformation in Armco iron and 1010 steel have been studied by X-ray diffraction techniques. It was found that both pseudo-macrostresses and microstresses exist. A qualitative theory, due to Weidemann et al for the oscillations in d vs sin squared psi caused by microstresses (and that lead to anomalous values of residual stress) has been placed on a quantitative basis and tested. A procedure has been developed for obtaining the true macrostress in the presence of such oscillations.
Author (GRA)

N72-30480# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DEVELOPMENT OF PRECIPITATION STRENGTHENED COLUMBIUM BASE ALLOYS Final Report, Mar. 1969 - Sep. 1970
J. A. Cornie Wright-Patterson AFB, Ohio AFML Dec. 1971 116 p refs
(Contract F33615-69-C-1464)
(AD-741930, AFML-TR-71-51) Avail: NTIS CSCL 11/6

A columbium base alloy composition, Cb-22W-4Hf-0.5C-0.05N (designated), was developed which can be thermally treated to alter its strength properties. In the as-solution annealed and aged condition, the 0.2% offset yield strength is 87,000 psi at 1400F and 82,000 psi at 2200F. Although developed primarily as a forging alloy, the composition can be processed to sheet with final rolling at 600F. The C-6 composition evolved from studies of Cb-22W base alloys with zirconium and hafnium additions in combination with carbon and/or nitrogen. Zirconium additions were superior to hafnium at the 2 atom percent level in enhancing response to thermal treatment. However, hafnium bearing compositions were more fabricable than those containing zirconium. Partial substitution of tungsten with molybdenum showed that on an atom for atom basis, molybdenum was half as effective as tungsten with respect to improving creep resistance but was equally detrimental in raising the ductile to brittle transition temperature.
Author (GRA)

N72-30481# Carnegie-Mellon Univ., Pittsburgh, Pa. Metals Research Lab.
GRAIN BOUNDARY SEGREGATION OF IMPURITIES IN METALS AND INTERGRANULAR BRITTLE FRACTURE
John R. Low, Jr., Craig L. Smith, and Fred W. Verdi May 1972 30 p refs
(Contract N00014-67-A-0314-0002; NR Proj. 031-727)
(AD-742072; CMU-031-727-4) Avail: NTIS CSCL 11/6

Grain boundary segregation in a Ni-Cr steel during temper embrittlement has been examined both by Auger electron analysis and by the analysis of etched residues from intercrystalline fracture surfaces. Auger analysis yields compositions averaged over all phases at the boundary, whereas the etching method used gives changes in ferrite only. An attempt to prevent Sb grain boundary segregation, by first segregating faster-diffusing P, did not greatly affect the embrittlement up to 1000 hours at 450C. There is one result which suggests that P may reduce Sb boundary segregation. This study will be extended to longer embrittling times. Author (GRA)

N72-30482# Army Foreign Science and Technology Center, Charlottesville, Va.
USE OF THE MICROHARDNESS METHOD FOR ESTIMATING THE ANISOTROPY OF PLASTIC FLOW OF MATERIALS IN LOCAL REGIONS

A. V. Gurey and G. V. Malovechko 21 Apr. 1972 10 p refs Transl. into ENGLISH from Zavodskaya Lab. (USSR), v. 36, no. 9, 1970 p 1119-1122
(AD-742112; FSTC-HT-23-659-72) Avail: NTIS CSCL 11/6

Studies of indentor methods of microhardness measurement have shown that anisotropy of plastic flow must be characterized by dimensional change in two characteristic directions; the direction of preponderant flow and the direction of inhibited flow, which may not be perpendicular to each other. GRA

N72-30483# Syracuse Univ., N.Y. Dept. of Chemical Engineering and Materials. Science.
THE SIGNIFICANCE OF MATERIAL DUCTILITY TO THE RELIABILITY AND LOAD CARRYING CAPACITY OF PEAK PERFORMANCE STRUCTURES Final Report, 1 Oct. 1970 31 Dec. 1971
Volker Weiss, Mukulesh Sengupta, and Dhirendra Lal Jan. 1972 91 p refs
(Contract N00019-71-C-0102)
(AD-741712; MS-VW-1915-F172) Avail: NTIS CSCL 11/6

The fracture ductilities are determined as a function of stress state for 2024-T4 Al, 7075-T6 Al, Ti-6Al-6V-2Sn (ann) Ti-2.5Al-16V (solution treated), AISI 4340 (R sub c = 39,35) and 250 grade maraging steel (48 R sub c). The studies concluded to date indicate that it is possible to achieve the objectives of developing design criteria against fracture on the basis of readily determinable material parameters. A discussion is given on the definition of the stress-strain relation exponent, n, in this context. The proposed analysis was applied to Al 2014-T6.
Author (GRA)

N72-30484# Franklin Inst., Philadelphia, Pa.
DEVELOPMENT OF ULTRA FINE GRAIN SIZE TITANIUM WITH IMPROVED MECHANICAL PROPERTIES Final Report
Robin L. Jones Mar. 1972 63 p refs
(Contract N00019-71-C-0133)
(AD-740850; F-C3013) Avail: NTIS CSCL 11/6

A two-part study of the effects of interstitial content, grain refinement and cold working on the mechanical properties of titanium-base materials was conducted. In the first part techniques were developed to refine the grain size of Ti-5Al-2.5Sn into the range of 0.5 microns, grain growth kinetics were evaluated and room temperature tensile behavior was investigated. In the second part of the program the effects of grain size and cold work on the room temperature toughness of Grade 3 unalloyed titanium sheet were investigated. Notched tensile, modified Kahn-type tearing, and fatigue crack propagation tests were employed. Strength increases were found to correspond to improved tear strength and reduced fatigue crack propagation rates while other toughness parameters were generally raised to some extent by grain refinement and lowered by cold working.
Author (GRA)

N72-30485# Battelle Memorial Inst., Columbus, Ohio. Metals and Ceramics Information Center.
IMPURITY EFFECTS IN BERYLLIUM
S. H. Gelles Mar. 1972 74 p refs Sponsored in part by AFML and Defense Supply Agency
(AD-741896; MCIC-72-06) Avail: NTIS CSCL 11/6

Research and development activities conducted over the past sixteen years have led from the discovery that commercially pure beryllium is an alloy to the development of new beryllium products having properties tailored to specialized applications. The path has been through understanding of the impurity reactions occurring and application of chemical controls and heat-treatment procedures to commercial production. In this report, the research efforts that have brought us to our present level of understanding of these reactions and their effects on mechanical properties of beryllium are traced and our current understanding of this field is summarized and assessed. Lastly, some of the grades of beryllium that have recently become available or are presently being developed are described and discussed briefly. Author (GRA)

N72-30486# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF ULTRAHIGH-STRENGTH, DUCTILE TITANIUM ALLOYS BY THERMOMECHANICAL PROCESSING AND TRANSFORMATION-INDUCED PLASTICITY Final Report, 1 Jan. - 31 Dec. 1971
Feb. 1972 34 p refs
(Contract N00019-71-C-0110; SRI Proj. 8979)
(AD-740115) Avail: NTIS CSCL 11/6

The report summarizes results of the second year of a program for development of TRIP-type titanium alloys. Ternary, quaternary, and more complex alloys were investigated for strain-or stress-induced martensitic transformation during tensile testing at room temperature. It was determined that molybdenum and vanadium-stabilized beta alloys do not transform martensitically during deformation. Microstructural features that looked like martensite were actually mechanical twins in the beta phase. Moreover, the stress to initiate twinning is low, thus causing premature yielding and anomalously low yield strengths. Author (GRA)

N72-30487# General Electric Co., Schenectady, N.Y.
TECHNOLOGY DEVELOPMENT FOR TRANSITION METAL-RARE EARTH HIGH PERFORMANCE MAGNETIC MATERIALS Semiannual Interim Technical Report, 1 Jul. - 31 Dec. 1971
Joseph J. Becker Apr. 1972 51 p refs
(Contract F33615-70-C-1626; ARPA Order 1617)
(AD-741848; SRD-72-036; satr-3; AFML-TR-72-29) Avail: NTIS CSCL 11/6

The objective of this work, is to develop the technology of high-performance transition metal-rare earth magnets for critical applications. High-performance permanent magnets are defined in this context as those having remanences greater than ten thousand gauss and permeabilities of very nearly unity throughout the second and into the third quadrants of their hysteresis loop. The progress that has been made during the period covered by the report is described under these three major headings. Fundamental studies of the origin of the coercive force in high-anisotropy materials; Materials characterization and phase equilibrium studies; Alloy development. GRA

N72-30488# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Metallurgical Engineering.
A STRUCTURAL STABILITY-MECHANICAL BEHAVIOR CORRELATION IN EUTECTIC Al-CuAl2
A. Pattnaik and A. Lawley Apr. 1972 36 p refs
(Contract N00014-67-A-0406-0001; NR Proj. 031-721; Drexel Proj. 336)
(AD-740826; TR-8) Avail: NTIS CSCL 11/4

Attention is directed to the effects of physicochemical instability and the associated structural changes on the ambient temperature mechanical behavior of lamellar Al-CuAl2. A detailed correlation is made of tensile yielding, flow, and fracture morphology. Author (GRA)

N72-30489# Army Foreign Science and Technology Center, Charlottesville, Va.
PLASTIC COMPRESSION. 3: THE ABSORPTION OF ENERGY BY A METAL UNDER PLASTIC COMPRESSION
N. F. Kunin and G. V. Senilev 20 Apr. 1972 21 p refs Transl. into ENGLISH from Tr. Sibirsk. Fiz. Tekhn. Inst. pri Tomsk. Gos. Univ. (Tomsk), v. 4, no. 3, 1936
(AD-741254; FSTC-HT-23-780-71) Avail: NTIS CSCL 11/6

Energy absorption by copper in plastic compression is shown in relation to deformation and total energy expended. The results obtained do not agree completely with those of Taylor and Quinney, showing, instead, a steady decrease in absorption with increasing deformation. Author (GRA)

N72-30490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CYCLIC STRENGTH OF TITANIUM ALLOYS

Yu. E. Zobachev, E. N. Kostrov, and E. D. Shekhovstsev 3 Feb. 1972 18 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Morsk. Flota (Leningrad), no. 116, 1969 p 107-117
(AF Proj. 7351)
(AD-741497; FTD-MT-24-1208-71) Avail: NTIS CSCL 11/6

Results of fatigue and corrosion fatigue tests of certain titanium alloys, materials that show promise in transport ship building, are presented. Tests for low cyclic fatigue in a corrosive environment revealed marked reduction in longevity of notched specimens. Author (GRA)

N72-30491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPERTIES OF CAST CHROMIUM-NICKEL ALLOYS CONTAINING NIOBIUM AND MOLYBDENUM
Yu. A. Nekhendzi and E. M. Iyonkina 2 Feb. 1972 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met. (Moscow), v. 13, no. 3, 1970 p 148-151
(AF Proj. 7351)
(AD-741493; FTD-MT-24-1125-71) Avail: NTIS CSCL 11/6

Alloys of the Ni-Cr-Nb and Ni-Cr-Nb-Mo system were studied for the purpose of determining the effect of various Nb and Mo concentrations on their microstructure and degree of dispersion hardening. GRA

N72-30492# Army Materials and Mechanics Research Center, Watertown, Mass.
EXPERIMENTAL OBSERVATION OF A STRESS INTENSITY HISTORY EFFECT UPON FATIGUE CRACK GROWTH RATE
William T. Matthews, Francis I. Baratta, and George W. Driscoll Sep. 1971 11 p
(DA-Proj. 1T0-62105-A-328)
(AD-740162; AMMRC-TR-71-38) Avail: NTIS CSCL 11/6

Experimental results illustrate a previously unreported stress intensity history effect following a step increase in stress intensity. Data for 12 of 24 cases of step increases in stress intensity are presented which show an initially enhanced crack growth rate of two to four times the steady state growth rate. The effect diminishes until the normal rate is reached after 0.025 to 0.150 inch of crack extension and 200 to 600 cycles. An associated study of the causes of this behavior is being undertaken. Author (GRA)

N72-30493# Connecticut Univ., Storrs. Dept. of Physics.
A STUDY OF CYCLIC FATIGUE DAMAGE IN COPPER-ALUMINUM ALLOYS BY THERMAL CONDUCTIVITY MEASUREMENTS Interim Report
Tak K. Chu and Frederick P. Lipschultz Feb. 1972 27 p refs
(Contract F44620-69-C-0011; AF Proj. 9560)
(AD-740593; AFOSR-72-0409TR) Avail: NTIS CSCL 11/6

Low temperature (4 K - 70 K) thermal conductivity measurements were carried out on two copper-aluminum (copper plus 1 at. % and 15 at. % aluminum) which have undergone various stages of fatiguing. From the temperature variation of the lattice component of the measured thermal conductivity, the dominant lattice imperfections introduced by fatiguing were determined. It is found that in the copper plus 1 at. % aluminum alloy, the damage is in the form of dislocation pile-ups. In the copper plus 15 at. % aluminum alloy, the damage is a random distribution of dislocations. This damage is of the same nature as that induced by uniaxial tensile deformation. Author (GRA)

N72-30494# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
HIGH TEMPERATURE OXIDATION OF METALS, ALLOYS AND CERAMIC CARBIDES AND BORIDES Final Report, Jul. 1966 - Sep. 1971
Henry C. Graham Jan. 1972 11 p refs
(AF Proj. 7021)
(AD-740941; ARL-72-0016) Avail: NTIS CSCL 11/6

A knowledge of high temperature oxidation mechanisms is fundamental to the design or improvement of vehicle materials which resist extreme oxidizing environments. The oxidation behavior of several Ni-base alloys was studied to 1200 C. ZrB2 and ZrB2-SiC oxidation was studied to 2000 C. Of particular importance in these studies were the determination of the oxidation reaction kinetics by continuous weight change measurements as a function of temperature and oxygen partial pressure. The major accomplishments of the research effort are summarized and the publications generated under this program are listed. Author (GRA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N72-30495*# McDonnell-Douglas Co., Huntington Beach, Calif. Advance Propulsion Dept.
DEVELOPMENT OF LIGHTWEIGHT MATERIAL COMPOSITES TO INSULATE CRYOGENIC TANKS FOR 30-DAY STORAGE IN OUTER SPACE Final Report
D. R. Krause Jun. 1972 515 p refs
(Contract NAS8-26006)
(NASA-CR-123828; MDC-G2742) Avail: NTIS HC $27.75 CSCL 11D

A conceptual design was developed for an MLI system which will meet the design constraints of an ILRV used for 7- to 30-day missions. The ten tasks are briefly described: (1) material survey and procurement, material property tests, and selection of composites to be considered; (2) definition of environmental parameters and tooling requirements, and thermal and structural design verification test definition; (3) definition of tanks and associated hardware to be used, and definition of MLI concepts to be considered; (4) thermal analyses, including purge, evacuation, and reentry repressurization analyses; (5) structural analyses (6) thermal degradation tests of composite and structural tests of fastener; (7) selection of MLI materials and system; (8) definition of a conceptual MLI system design; (9) evaluation of nondestructive inspection techniques and definition of procedures for repair of damaged areas; and (10) preparation of preliminary specifications. Author

N72-30496*# MSC White Sands Test Facility, N.Mex.
FLASH AND FIRE TEST: EVALUATION OF THE BEHAVIOR OF NONMETALLIC MATERIALS IN HYDROGEN Summary Report
30 Mar. 1972 75 p Original contains color illustrations
(NASA-TM-X-68739; TR-196-002) Avail: NTIS HC $5.75 CSCL 11D

Tests conducted to evaluate the behavior of nonmetallic materials in hydrogen are described. The results of the flash and fire test are presented. The flash and fire test is used to evaluate the tendency of heated materials to ignite in a hydrogen atmosphere when subjected to an ignition source. The test represents a hydrogen parallel to a hazard condition known to exist in oxygen systems. Ten nonmetallic materials were evaluated to establish baseline data on the behavior of the materials and to characterize one mode of material failure considered to be a factor pertinent to the safe use of a material in hydrogen. Author

N72-30497*# Thermo Electron Corp., Waltham, Mass.
DEVELOPMENT AND FABRICATION OF INSULATOR SEALS FOR THERMIONIC DIODES Final Report
Victor L. Poirier Jun. 1972 64 p Prepared for JPL
(Contract NAS7-100; JPL-953179)

(NASA-CR-128021; TE5257-1-73) Avail: NTIS HC $5.25 CSCL 11A

Eight different types of cermet seals for thermionic diodes were investigated: (1) 1 micron Al2O3 with Nb spheres; (2) 200 A Al2O3 with Nb spheres; (3) 1 micron Al2O3 with Nb 1% Zr spheres; (4) 200 A Al2O3 with Nb 1% Zr spheres; (5) Pure Y2O3 with Nb 1% Zr spheres; (6) Y2O3 3% ZrO2 with Nb 1% Zr spheres; (7) Y2O3 10% ZrO2 with Nb 1% Zr spheres; and (8) ZrO2 12% Y2O3 with Nb 1% Zr spheres. Investigations were made to determine the most favorable fabrication techniques and the effect of the bonding cycle, (length of bonding time and shutdown sequences). The analysis of the seals included tensile test, vacuum test, electrical test and metallurgical examination. At the conclusion of the development phase, 36 seals were fabricated for delivery for evaluation. Author

N72-30498*# Dynatech Corp., Cambridge, Mass.
DEVELOPMENT OF SELF EXTINGUISHING DURETTE AND/OR NOMEX FABRIC Final Report
20 Jun. 1972 28 p ref
(Contract NAS9-12247)
(NASA-CR-115765; Rept-1033) Avail: NTIS HC $3.50 CSCL 11E

A treatment was developed for Nomex or Durette fabric which renders it self-extinguishing in a 70% oxygen, 30% nitrogen atmosphere at 5 psia. The treatment does not degrade the physical and textile properties of the fabric excessively and does not outgas or have an objectional odor. The treatment is permanent and does not lose its fire protecting qualities after laundering. The treatment utilizes a mixture of formaldehyde, phosphorous acid, and tri-methyl phosphate in methanol. The cloth to be treated is held in a boiling solution of the above reagents for 24 hours, removed, air dried, and then heated to 120 C in a circulating air oven for 90 minutes. The treatment turns Nomex a pale yellow but does not have an appreciable effect on drape or hand. One inch wide strips of treated cloth failed in tension at 192 lbs, while untreated controls broke at 215 lbs. To remove any excess reagents, the cloth is processed in a home laundry through one wash and dry cycle without the use of any detergents. The thermal shrinkage of the treated material is 23% compared to a control of 40% for unwashed Stern Nomex HT 90-40. Author

N72-30499*# Materials Sciences Corp., Blue Bell, Pa.
TENSILE FAILURE CRITERIA FOR FIBER COMPOSITE MATERIALS
B. Walter Rosen and Carl H. Zweben Washington NASA Aug. 1972 167 p refs
(Contract NAS1-10134)
(NASA-CR-2057) Avail: NTIS HC $3.00 CSCL 11D

The analysis provides insight into the failure mechanics of these materials and defines criteria which serve as tools for preliminary design material selection and for material reliability assessment. The model incorporates both dispersed and propagation type failures and includes the influence of material heterogeneity. The important effects of localized matrix damage and post-failure matrix shear stress transfer are included in the treatment. The model is used to evaluate the influence of key parameters on the failure of several commonly used fiber-matrix systems. Analyses of three possible failure modes were developed. These modes are the fiber break propagation mode, the cumulative group fracture mode, and the weakest link mode. Application of the new model to composite material systems has indicated several results which require attention in the development of reliable structural composites. Prominent among these are the size effect and the influence of fiber strength variability. Author

N72-30500*# Houston Research, Inc., Tex.
THERMAL CONDUCTIVITY OF FILLED RTV COMPOUNDS Final Report
Charles E. Mauk 24 Jul. 1972 20 p
(Contract NAS9-6698)
(NASA-CR-128520) Avail: NTIS HC $3.00 CSCL 11A

Sealant materials with high thermal conductivity, and electrically nonconductive were studied for applications. Alumina and other thermally conductive fillers were examined for room temperature vulcanizing (RTV) use. The guarded hot plate apparatus, and its operation are described, and results of the thermal conductivity tests are discussed. It was found that magnesium oxide is significantly better than aluminum oxide as a filler enhancing the thermal conductivity of RTV. Recommendations for future studies are included. F.O.S.

N72-30501*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF NONFLAMMABLE CELLULOSIC FOAMS Final Report
Manfred Luttinger 27 Jul. 1972 31 p refs
(Contract NAS9-12412)
(NASA-CR-128512) Avail: NTIS HC $3.75 CSCL 11D

The development of a moldable cellulosic foam for use in Skylab instrument storage cushions is considered. Requirements include density of 10 lb cu ft or less, minimal friability with normal handling, and nonflammability in an atmosphere of 70 percent oxygen and 30 percent nitrogen at 6.2 psia. A study of halogenated foam components was made, including more highly chlorinated binders, halogen-containing additives, and halogenation of the cellulose. The immediate objective was to reduce the density of the foam through reduction in inorganic phosphate without sacrificing flame-retarding properties of the foams. The use of frothing techniques was investigated, with particular emphasis on a urea-formaldehyde foam. Halogen-containing flame retardants were deemphasized in favor of inorganic salts and the preparation of phosphate and sulphate esters of cellulose. Utilization of foam products for civilian applications was also considered. Author

N72-30502*# Engelhard Minerals and Chemicals Corp., Newark, N.J. Research and Development Dept.
DEVELOPMENT OF PLATINUM-THORIUM OXIDE ALLOY FOR RESISTOJET THRUSTER USE Final Report
H. J. Albert and J. S. Hill Jul. 1971 37 p
(Contract NAS1-10433)
(NASA-CR-111959) Avail: NTIS HC $4.00 CSCL 11D

Testing of platinum-thoria alloys has established that under the conditions determined for the preparation of these alloys, platinum with 0.6% thoria is the optimum composition from the point of view of manufacturing and usage of the alloy. Stress-rupture testing shows a considerable increase in stress-rupture life for platinum-thoria alloys over the commercial platinum-rhodium alloys. Adding thoria to platinum at the 0.6% level has relatively little effect on the room temperature mechanical and electrical properties. The principal effect of the thoria is to provide a stable, elongated grain structure, thereby improving the long term, load carrying capacity at elevated temperatures. Tubing was fabricated without difficulty from the platinum 0.6% thoria alloys. Joining tests were carried out by electron beam welding, dap welding, diffusion bonding, spot welding and high temperature brazing. Author

N72-30503*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUANTITATIVE X-RAY DIFFRACTION ANALYSIS OF OXIDES FORMED ON SUPERALLOYS
Ralph G. Garlick Washington Sep. 1972 14 p refs
(NASA-TM-X-2627; E-6911) Avail: NTIS HC $3.00 CSCL 11D

Methods were developed for quantitative analysis by X-ray diffraction of the oxides Al2O3, NiO, Cr2O3, CoO, and CoCr2O4 within a standard deviation of about 10 percent of the weight fraction reported or within 1 percent absolute. These error limits assume that the sample oxides are well characterized and that the physiochemical structure of the oxides in the samples are identical with those in the synthesized standards. Results are given for the use of one of the techniques in the analysis of spalls from a series of oxidation tests of the cobalt base alloy WI-52. Author

N72-30504# Joint Publications Research Service, Arlington, Va.
COMPUTING THE STEADY PARAMETERS OF THE ABLATION OF GLASSY MATERIALS
B. I. Reznikov 16 Aug. 1972 9 p refs Transl. into ENGLISH from Tr. Leningrad. Politekh. Inst. (Leningrad), no. 265, 1966 p 60-64
(JPRS-56782) Avail: NTIS HC $3.00

The characteristics of vitreous materials formed from silica compounds and used for thermal protection against aerodynamic heating are discussed. The boundary layer equations for establishing the stationary parameters for their breakdown are developed. A method is suggested for solving the liquid film equations which can be converted to nomograms suitable for use in engineering problems. The application of the data in estimating ablation parameters of more complex materials breaking down with the formation of a glassy film is explained.
Author

N72-30505# Institut fuer Festkoerpermechanik, Freiburg (West Germany).
SHOCK INDUCED WAVE PROPAGATION IN A LINEAR VISCOELASTIC BAR [LUFTSTOSS - INDUZIERTE WELLENAUSBREITUNG IN EINEM LINEAR VISKOELASTISCHEN STAB]
U. Soltesz Nov. 1971 62 p refs In GERMAN; ENGLISH summary
(WB-3/71) Avail: NTIS HC $5.25

Calculations and tests are presented of shock tube induced one-dimensional shock wave propagation in a thin linear visco elastic bar of solithane 113 material. The wave propagation is examined stress-optically by means of high speed photography. The apparatus is described, the results are given, and the differences between calculations and experimental results are discussed, the main difference being between predicted and measured isochromate response.
ESRO

N72-30506# Explosives Research and Development Establishment, Waltham Abbey (England).
LOW TEMPERATURE FLEXIBILITY OF ELASTOMERS
B. E. Brokenbrow, D. Sims, and A. L. Stokoe Aug. 1970 26 p ref
(ERDE-TR-40; BR23439) Avail: NTIS HC $3.50

The torsional modulus of twenty-five rubber compounds and four flexible plastics has been measured as a function of temperature using a standard apparatus. Corresponding room temperature tensile properties are also given. A limiting low temperature has been reported for all the materials studied based on a torsional modulus of 10,000 psi (69 MN/sq m). Alternative limits based on 100 MN/sg m and 100 times the room temperature modulus are also given. The limiting temperatures given by the use of these arbitrary standards fall close to each other for a given material.
Author (ESRO)

N72-30507# Explosives Research and Development Establishment, Waltham Abbey (England).
RELATIONSHIPS BETWEEN POLYURETHANE ELASTOMER STRUCTURE AND AGEING PROPERTIES. PART 4: EFFECT OF DI-ISOCYANATE
B. E. Brokenbrow, D. Sims, and J. Wright Jun. 1971 38 p refs
(ERDE-TR-68-Pt-4; BR28516) Avail: NTIS HC $4.00

The effect of varying the diisocyanate on the aging properties of polyurethane elastomers is described. Polyester and polyether urethane elastomers were prepared with selected diisocyanates and crosslinked and/or chain extended with either 1, 1', 1-trimethylol propane (TMP) or mixtures of TMP and 4, 4'-methylene bis (2-chloro aniline), MOCA. Elastomers prepared with toluene diisocyanate TDI gave the most satisfactory initial properties and resistance to aging in dry air at 80 C, water at 22 and 80 C, and STF (petrol) at 65 C. None of the elastomers prepared from the other diisocyanates examined had equally satisfactory all round properties to those based on TDI.
ESRO

N72-30508# Explosives Research and Development Establishment, Waltham Abbey (England).
RELATIONSHIPS BETWEEN POLYURETHANE ELASTOMER STRUCTURE AND AGEING PROPERTIES. PART 2: EFFECT OF BACKBONE POLYOL
B. E. Brokenbrow, D. Sims, and J. Wright Jun. 1971 27 p refs
(ERDE-TR-53) Avail: NTIS HC $3.50

The effects of varying the backbone polyol on the properties of polyurethane elastomers were investigated. Unaged polyester urethanes, especially those based on polyethylene and polybutylene adipates (mol wt 2000), were generally tougher but considerably less resistant to hydrolysis than polyurethanes prepared from polyethers of similar molecular weights. Low molecular weight polyols (650 to 1260) led to more highly crosslinked elastomers with improved tensile strength, modulus, hardness, but with reduced flexibility. Elastomers based on hydroxyl-terminated polybutadiene urethanes and to a lesser extent polyoxybutylene glycol urethanes (mol wt 1300), showed the best resistance to hydrolysis at 80 C, while those based on polydiethylene adipate (mol wt 1000) and polyoxypropylene glycol (mol wt 1250) showed the best resistance to petrol (STF) at 65 C.
Author (ESRO)

N72-30509# Explosives Research and Development Establishment, Waltham Abbey (England).
RELATIONSHIPS BETWEEN POLYURETHANE ELASTOMER STRUCTURE AND AGEING PROPERTIES: PART 3: EFFECTIVE CROSSLINK STRUCTURE
B. E. Brokenbrow, D. Sims, and J. Wright Jun. 1971 28 p refs
(ERDE-TR-54) Avail: NTIS HC $3.50

The effect of varying chemical group structure on the properties of polyurethane elastomers has been investigated. The introduction of urea and biuret groups into polyester and polyether urethanes by the use of 4,4,-methylene bis-(2-chloroaniline), MOCA, yielded elastomers with superior physical properties to elastomers which contained predominantly urethane groups and were chain extended and/or crosslinked with diols and triols. MOCA cured polyester urethanes gave higher tensile strengths with better resistance to dry air and STF (petrol) than polyether urethanes cured in the same way; while MOCA cured polyether urethanes were harder and had superior hydrolytic stability compared to polyester urethanes.
Author (ESRO)

N72-30510# California Univ., Los Angeles. School of Engineering and Applied Science.
THE MECHANICAL PROPERTIES OF NICKEL OXIDE AND THEIR RELATIONSHIP TO THE MORPHOLOGY OF THICK OXIDE SCALES FORMED ON NICKEL Final report
Anthony G. Evans, Dilip Rajdev, and David L. Douglas Apr. 1972 42 p refs
(Contract N00014-69-A-0200-4021; NR Proj. 048-239)
(AD-741710; UCLA-ENG-7229) Avail: NTIS CSCL 11/2

The oxidation of metals that form P-type semiconducting oxide scales, such as NiO on nickel and CoO on cobalt, takes place by outward cation diffusion and inward vacancy diffusion. The large number of cation vacancies precipitate in the scale near the oxide-metal interface and many coalesce to form macroscopic pores, resulting in a transition from a dense, columnar scale to a duplex scale which contains an inner, fine-grain equiaxed, porous layer. Increasing temperature and/or purity eliminate the transition, which has been found to depend upon oxide plasticity. The mechanical properties of bulk nickel oxides having a range of porosities have been studied in compression. The development of the duplex structure in scales during oxidation has been shown to depend upon inhibition of slip. Grain size, porosity, and impurities play an important role; all of these effects are discussed in detail.
Author (GRA)

N72-30511# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
MICROBUCKLING OF UNIDIRECTIONAL COMPOSITES

L. B. Greszczuk Wright-Patterson AFB, Ohio AFML Jan. 1972 105 p refs
(Contracts F33615-71-C-1070; F33615-67-C-1559; AF Proj. 7340)
(AD-742282; AFML-TR-71-231) Avail: NTIS CSCL 11/4

A review is presented of the theories for microbuckling of unidirectional composites subjected to compressive loading parallel to the fiber direction. The results predicted by the various theories are compared. Large differences in predicted results are shown to exist for microbuckling in the extension mode. In the case of microbuckling in the shear mode, the various theories predict the same results. Nearly perfect (as compared to actual composites) model composites consisting of circular rods in an epoxy matrix are employed to obtain experimental data on failure of unidirectional composites subjected to compressive loading. The constituent materials used in preparation of model are characterized for their mechanical properties. Two types of reinforcement materials and four different resins are used in the experimental phase of the program. Author (GRA)

N72-30512# Army Foreign Science and Technology Center, Charlottesville, Va.
POWDER POLYMER MATERIALS AND COATINGS BASED ON THEM
A. D. Yakovlev, V. F. Zdor, and V. I. Kaplan 22 Mar. 1972 267 p refs Transl. into ENGLISH from Poroshkovye Polimernye Materialy i Pokrytiya Na Ikh Osnove (Leningrad), 1971 253 p
(AD-742019; FSTC-HT-23-1025-72) Avail: NTIS CSCL 11/3

The report discusses the methods of production of powder polymer materials, principles of film formation and production of coatings on the basis of these materials. Considerable attention is given to the technology of production of films and the methods of application of polymer materials onto surfaces, including equipment used. Author (GRA)

N72-30513# Army Foreign Science and Technology Center, Charlottesville, Va.
STUDY OF PHOTOTECHNICAL CHARACTERISTICS OF POLYMER FILMS USED AS TRANSPARENT COATINGS IN SOLAR WATER HEATERS
A. Zhamalov 1972 9 p refs Transl. into ENGLISH from Geliotekh. (ussr), no. 4, 1970 p 29-33
(AD-742111; FSTC-HT-23-1580-71) Avail: NTIS CSCL 11/9

The light transmittance and the reflection coefficients delta of polyamide PK-4, polyethylene terephthalate, and polyethylene films were determined. The 75 micrometers thick films absorbed the following amounts of solar light: PK-4 0.5%, I 0.5%, and II 0.2%. The films were recommended for use in solar water heaters. Author (GRA)

N72-30514# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
THE EFFECTS OF HIGH INTENSITY ELECTRICAL CURRENTS ON ADVANCED COMPOSITE MATERIALS Final Report
A. P. Penton, J. L. Perry, and K. J. Lloyd 21 Mar. 1972 149 p refs Prepared in cooperation with General Electric Co., Pittsfield, Mass.
(Contract N00019-71-C-0063)
(AD-740822; U-5018) Avail: NTIS CSCL 11/4

The objective of the program was to perform a research study to investigate high intensity electric current flow of such magnitude and waveform as might result from lightning strikes, and to characterize the resulting degradation in advanced composites and to investigate means of providing internal protection from such damage. Author (GRA)

N72-30515# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.
CARBORANE POLYMERS, A SUMMARY
Hansjuergen A. Schroeder Apr. 1972 9 p refs
(Contract N00014-71-C-0003; NR Proj. 356-431)
(AD-742444; TR-50) Avail: NTIS CSCL 11/9

The various types of existing carborane-based polymers are broadly surveyed with regard to structures, physical properties, thermal stabilities and end-use applications. Author (GRA)

N72-30516# Picatinny Arsenal, Dover, N.J. Materials Engineering Div.
INTERRUPTED STRESS-STRAIN EXPERIMENTS WITH NYLON 6
Jerome Rubin Mar. 1972 25 p refs
(DA Proj. 1T0-61102-B-13A)
(AD-740650; PA-TM-2029) Avail: NTIS CSCL 11/9

Samples of nylon 6 were subjected to drawing from a few percent to greater than a hundred percent and allowed to stress relax. This involved elongating the sample to a certain point and then keeping the length constant. When the sample is momentarily held in the peak of the original yield point and then pulled again, a higher-than-original yield peak develops. Subsequent interruptions followed by drawing resulted in the formation of additional yield peaks. In each of these latter cases, the new yield peak is lower than the original. The height of the new yield peak formed is related to the time allowed for stress relaxation. It is shown that the stress relaxation plays an integral role in the structural rearrangements which lead to the development of additional yield peaks. Author (GRA)

N72-30517# Monsanto Research Corp., Dayton, Ohio.
IMPROVING ULTRASONIC TRANSDUCER ASSEMBLIES GENERATING AEROSOLS FOR INSTRUMENTAL TECHNIQUES OF CHEMICAL ANALYSIS Final Report, 1 Dec. 1970 - 31 May 1971
Louis E. Owen Oct. 1971 19 p refs
(Contract F33615-71-C-1132; AF Proj. 7360)
(AD-741846; MRC-DA-305; AFML-TR-71-161) Avail: NTIS CSCL 11/3

The intent of this contract effort was to improve transducers employed in direct impingement ultrasonic nebulizers. Improved mounts providing better cooling were to be devised and superior surface coatings protecting active nebulizing surfaces from chemical attack were to be sought. During the contract period principal effort was given to the development of chemical-resistant coatings for the piezoelectric elements employed as nebulizing devices. Author (GRA)

N72-30518# Stanford Univ., Calif. Center for Materials Research.
MATERIALS RESEARCH AT STANFORD UNIVERSITY Annual Report, 1 Jul. 1970 - 30 Jun. 1971
30 Jul. 1971 302 p refs
(Contracts ARPA SD-87; DAHC15-67-C-0218)
(AD-741853; CMR-71-17; AR-10) Avail: NTIS CSCL 11/7

The report contains brief descriptions of the various individual research programs active during the period July 1970 through June 1971. Author (GRA)

N72-30519# Avco Corp., Wilmington, Mass. Systems, Div.
MICROSTRUCTURE STUDIES OF REFRACTORY POLYCRYSTALLINE OXIDES Summary Report, 9 Mar. 1971 - 9 Jan. 1972
William H. Rhodes, Philip L. Berneburg, and Rowland M. Cannon Jan. 1972 74 p refs
(Contract N00019-71-C-0325)
(AD-740828) Avail: NTIS CSCL 11/2

The program was divided into three tasks within the general topic of microstructure effects on properties of polycrystalline oxides. The first task was concerned with the identification, origin, and elimination of strength limiting flaws in fine grained high density hot pressed alumina. The principal strength limiting material flaws were either defects traceable to chemical contamination or large grains grown by exaggerated growth. The discussion also dealt with the implications of these findings on the various brittle fracture theories. The fabrication of

complex alumina shapes by the press forging process was studied with a goal of achieving not only the prescribed shape, but the unique optical and mechanical properties of press forged alumina. The consolidation of high purity fine particulate organo-metallic derived Al203 was studied. Author (GRA)

N72-30520# IIT Research Inst., Chicago, Ill.
FATIGUE BEHAVIOR OF GRAPHITE COMPOSITES Final Report, 9 Feb. 1971 - 8 Feb. 1972
P. N. Rao and K. E. Hofer, Jr. Feb. 1972 93 p refs
(Contract N00019-71-C-0212; IITRI Proj. D6060)
(AD-741580; IITRI-D6060-FR) Avail: NTIS CSCL 11/4

The work reported consists of two phases of investigation aimed at improving the material behavior of a graphite/epoxy prepreg composite with particular relevence to its fatigue performance. The first phase deals with the improvement of Modmor II/Narmco 5206 composite fatigue strength and its resistance to fatigue damage by interleaving the composite prepreg laminate with glass scrim cloth. The second phase consists of flexural strength studies investigating the effects of ambient aging of Modmor II/Narmco 5206 prepreg composites on their elevated temperature properties. In both phases of this investigation, the addition of glass scrim cloth contributes to an improvement in the mechanical behavior of graphite/epoxy prepreg composite. Author (GRA)

N72-30521# California Univ., San Diego. Dept. of the Aerospace and Mechanical Engineering Sciences.
GENERAL VARIATIONAL METHODS FOR WAVES IN ELASTIC COMPOSITES
S. Nemat-Nasser Jan. 1972 46 p refs
(Grant AF-AFOSR-1957-70; AF Proj. 9782)
(AD-740595; AFOSR-72-0321TR; TR-4) Avail: NTIS CSCL 11/4

General variational theorems in which the displacement, the stress, and the strain in one case, and the displacement and the stress in another case, are given independent variations, and which include appropriate general boundary and discontinuity conditions, are developed with a view toward the application to harmonic waves in elastic composites with periodic structures. The one-dimensional case is first developed in detail, and in order to demonstrate the effectiveness of the results, especially their accuracy in providing the dispersion curve, waves propagating normal to layers in a layered composite are discussed, and numerical results are presented; see Tables I and II. Then the general three-dimensional case is considered, and the results are applied to waves propagating normal to the fibers in a fiber-reinforced composite. Author (GRA)

N72-30522# Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
CRIMP AND THICKNESS RELATIONSHIPS IN MAXIMUM WEAVABLE FABRICS
Louis I. Weiner Mar. 1972 57 p refs
(DA Proj. 1T0-62105-A-329)
(AD-740161; C/PLSEL-TS-182; USA-NLABS-TR-72-45-CE) Avail: NTIS CSCL 11/5

Derivation of the basic equations and computer solution and tabling of values of overall crimp and cover factor in terms of displacement ratio (h/D) and spacing ratio (p/D) are provided for maximum weavable constructions in plain, three-, four-, and five-harness weaves and for yarn balance (Beta) values ranging from 0.5 to 2.0. Author (GRA)

N72-30523# United Aircraft Corp., East Hartford, Conn. Research Labs.
METAL MATRIX COMPOSITE TECHNOLOGY Final Report, 1 Jul. 1969 - 30 Jun. 1971
Kenneth G. Kreider, L. E. Dardi, and K. M. Prewo Dec. 1971 359 p refs
(Contract F33615-69-C-1539; AF Proj. 7351)
(AD-740584; K910853-12; AFML-TR-71-204) Avail: NTIS CSCL 11/4

The goals of the program include a critical property evaluation of the best aluminum and titanium alloy matrix boron composite systems available today and improvement of the understanding of fracture in metal matrix composites. This program is intended to develop criteria for material selection and metallurgical processing and to generate data to guide the structural engineer in designing with metal matrix composites. Areas of concentrated studies include: environmental effects, including exposure to sea water, high temperatures, and thermal cycling; transverse properties; off-axis properties; failure mechanisms of fatigue; notch bending fracture; and notched tensile fracture. Author (GRA)

N72-30524# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DIELECTRIC PROPERTIES OF POLYTETRAFLUOROETHYLENE DURING IRRADIATION WITH Co-60 GAMMA-RAYS AND FAST ELECTRONS
V. K. Matveev, S. E. Vaisberg, and V. L. Karpov 14 Jan. 1972 12 p refs Transl. into ENGLISH from Vysokomol. Soedin., Ser. B (Moscow), v. 12, no. 1, 1970 p 31-35
(AD-740347; FTD-HT-23-1224-71) Avail: NTIS CSCL 11/9

It has been confirmed that the sharp increases of dielectric losses in polytetrafluoroethylene during irradiation in air (or in a vacuum) without preliminary degassing of the specimens) is caused by the formation of peroxide radicals. It has been shown that during irradiation in air with a dose power of 250 rad/s the growth of the tangent of dielectric losses in polytetrafluoroethylene is not limited by the rate of oxygen diffusion, where as with a given dose power of rad/s such a limitation takes place. The contribution of each of the two types of peroxide radicals (terminal and intrachain) to increasing the dielectric losses in polytetrafluoroethylene is shown. Author (GRA)

N72-30525# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
MIL-C-6799, STRIPPABLE COATING EVALUATION Final Report, 24 Jan. - 11 Feb. 1972
William R. Drake Feb. 1972 25 p
(AD-740895; DSPS-72-1) Avail: NTIS CSCL 11/3

The report discusses results of a series of tests intended to detect deterioration in physical properties of various MIL-C-6799 strippable coating samples taken from service at the Military Aircraft Storage and Disposition Center. GRA

N72-30886* European Space Vehicle Launcher Development Organization, Paris (France).
EUROPEAN TECHNOLOGY ON COMPOSITE MATERIALS
J. Fray (Hawker Siddeley Dyn. Ltd.), A. W. Kitchenside (Brit. Aircraft Corp.), J. J. Cools (Roy. Neth. Aircraft Factories Fokker), C. P. H. Hanselmann (Maschinenfabrik Augsburg-Nuernberg A.G.), and R. J. Jonke *In* NASA, Washington NASA Space Shuttle Technol. Conf. Jul. 1972 p 645-684 refs (For availability see N72-30865 21-31)
CSCL 11D

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N72-30526*# Michigan Univ., Ann Arbor. Logic of Computers Group.
COMPARISON OF GENETIC ALGORITHMS WITH CONJUGATE GRADIENT METHODS
Jack L. Bosworth, Norman Y. Foo, and Bernard P. Zeigler Washington NASA Aug. 1972 44 p refs

(Grant NGR-23-005-427)
(NASA-CR-2093; Rept-003120-1-T) Avail: NTIS HC $3.00 CSCL 12A

Genetic algorithms for mathematical function optimization are modeled on search strategies employed in natural adaptation. Comparisons of genetic algorithms with conjugate gradient methods, which were made on an IBM 1800 digital computer, show that genetic algorithms display superior performance over gradient methods for functions which are poorly behaved mathematically, for multimodal functions, and for functions obscured by additive random noise. Genetic methods offer performance comparable to gradient methods for many of the standard functions. Author

N72-30527*# Michigan Univ., Ann Arbor. Logic of Computers Group.
ALGEBRAIC, GEOMETRIC, AND STOCHASTIC ASPECTS OF GENETIC OPERATORS
N. Y. Foo and J. L. Bosworth Washington NASA Aug. 1972 61 p refs
(Grant NGR-23-005-427)
(NASA-CR-2099; Rept-003120-2-T) Avail: NTIS HC $3.00 CSCL 12A

Genetic algorithms for function optimization employ genetic operators patterned after those observed in search strategies employed in natural adaptation. Two of these operators, crossover and inversion, are interpreted in terms of their algebraic and geometric properties. Stochastic models of the operators are developed which are employed in Monte Carlo simulations of their behavior. Author

N72-30528# Rice Univ., Houston, Tex.
QUADRATICALLY CONVERGENT ALGORITHMS AND ONE-DIMENSIONAL SEARCH SCHEMES
H. Y. Huang and J. P. Chambliss 1972 27 p refs
(Grant NSF GP-32453)
(AAR-87) Avail: NTIS HC $3.50

The performances of three quadratically convergent algorithms coupled with four one-dimensional search schemes are studied through several nonquadratic examples. The three algorithms are the rank-one algorithm (Algorithm 1), the projection algorithm (Algorithm 2), and the Fletcher-Reeves algorithm (Algorithm 3). The four search schemes are the exact quadratic search (EQS), the exact cubic search (ECS), the approximate quadratic search (AQS), and the approximate cubic search (ACS). The performances are analyzed in terms of the number of iterations and the number of equivalent function evaluations. The former is used as the criterion for the workability, or the ability to converge, while the latter is used as a measure of the total computation involved. Author

N72-30529# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
A CAUCHY PROBLEM FOR MILNES INTEGRAL EQUATION WITH A PINCHERLE-GOURSAT KERNEL
S. Ueno Aug. 1972 14 p refs
(Contract AT(40-3)-113; Grant NSF GP-29049; Proj. 19)
(USC-113P19-25; TR-72-42) Avail: NTIS HC $3.00

With the aid of invariant imbedding technique, the Cauchy system is obtained for the required solution of Milne's integral equation and the Fredholm resolvent. The integro-differential equations are reduced to large system of ordinary differential equations with known initial conditions. Then, they are suitable for the numerical computation of the solution by the modern high-speed computers. Author

N72-30530# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
A NOTE ON THE MATRIX RICCATI EQUATIONS. 2: TRANSPORT PROCESSES WITH SOURCES
R. Vasudevan Jul. 1972 13 p refs
(Grant GM-16197-04)
(TR-72-32) Avail: NTIS HC $3.00

The method of linearizing the Riccati equations is applied to treat the Riccati equation given rise to by the transport problems in a medium with sources. The internal and external fluxes can be computed to any desired order of approximation. This method can be of great help in many identification problems that arise in internal dosimetry. Author

N72-30531*# IBM Watson Research Center, Yorktown Heights, N.Y.
DESIGN OF AUTOMATA THEORY OF CUBICAL COMPLEXES WITH APPLICATIONS TO DIAGNOSIS AND ALGORITHMIC DESCRIPTION Final Report
J. Paul Roth 11 Apr. 1972 43 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952709)
(NASA-CR-127887; RC-3814) Avail: NTIS HC $4.25 CSCL 12A

The following problems are considered: (1) methods for development of logic design together with algorithms, so that it is possible to compute a test for any failure in the logic design, if such a test exists, and developing algorithms and heuristics for the purpose of minimizing the computation for tests; and (2) a method of design of logic for ultra LSI (large scale integration). It was discovered that the so-called quantum calculus can be extended to render it possible: (1) to describe the functional behavior of a mechanism component by component, and (2) to compute tests for failures, in the mechanism, using the diagnosis algorithm. The development of an algorithm for the multioutput two-level minimization problem is presented and the program MIN 360 was written for this algorithm. The program has options of mode (exact minimum or various approximations), cost function, cost bound, etc., providing flexibility. Author

N72-30532*# Cincinnati Univ., Ohio. Dept. of Engineering Analysis.
AN ANALYSIS OF GENERAL CHAIN SYSTEMS
C. E. Passerello and R. L. Huston [1972] 55 p refs
(Grant NGL-36-004-014)
(NASA-CR-127924) Avail: NTIS HC $4.75 CSCL 12A

A general analysis of dynamic systems consisting of connected rigid bodies is presented. The number of bodies and their manner of connection is arbitrary so long as no closed loops are formed. The analysis represents a dynamic finite element method, which is computer-oriented and designed so that nonworking, interval constraint forces are automatically eliminated. The method is based upon Lagrange's form of d'Alembert's principle. Shifter matrix transformations are used with the geometrical aspects of the analysis. The method is illustrated with a space manipulator. Author

N72-30533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
KULLBACK-LEIBLER INFORMATION FUNCTION AND THE SEQUENTIAL SELECTION OF EXPERIMENTS TO DISCRIMINATE AMONG SEVERAL LINEAR MODELS
Steven M. Sidik 17 Aug. 1972 61 p refs Presented at Ann. Meeting of Am. Statist. Assoc., Montreal, 14-17 Aug. 1972
(NASA-TM-X-68108) Avail: NTIS HC $5.25 CSCL 12A

The error variance of the process prior multivariate normal distributions of the parameters of the models are assumed to be specified, prior probabilities of the models being correct. A rule for termination of sampling is proposed. Upon termination, the model with the largest posterior probability is chosen as correct. If sampling is not terminated, posterior probabilities of the models and posterior distributions of the parameters are computed. An experiment was chosen to maximize the expected Kullback-Leibler information function. Monte Carlo simulation experiments were performed to investigate large and small sample behavior of the sequential adaptive procedure. Author

N72-30534# RAND Corp., Santa Monica, Calif.
SIMULTANEOUS ESTIMATION OF PARAMETERS
Bradley Efron (Stanford Univ., Calif.) and Carl Morris May 1972

47 p refs
(P-4835) Avail: NTIS HC $4.50

An introduction is presented to the concepts involved in simultaneous estimation and the results are stated precisely, giving proofs for some of them. The application and limitations of the method are discussed. Motivation is provided to show why the usual estimator is inappropriate and also to show how one might find better estimators. Author

N72-30535# Northeastern Univ., Boston, Mass. Dept. of Physics.
SOLUTION TO ONE DIMENSIONAL SCHROEDINGER EQUATION FOR AN ARBITRARY POTENTIAL; APPLICATION TO RADIAL EQUATION IN THREE DIMENSIONS
James L. Sigel Jun. 1972 7 p refs Sponsored in part by NSF
(NUB-2139) Avail: NTIS HC $3.00

The work of Reading and Sigel on the solution to the one-dimensional Schroedinger equation for a particle moving in the presence of a collection of delta function potentials of arbitrary strength and position is generalized, so that any arbitrary potential V(x) can be handled. A close connection is shown to exist between the methods described and those, involving Jost functions, which were developed for handling the radial Schroedinger equation in three dimensions. Author

N72-30536# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
MATHEMATICAL BIOSCIENCES PROGRAM Technical Report, 1 Jul. 1966 - 30 Jun. 1972
Richard Bellman 30 Jun. 1972 62 p refs
(Contract AT(40-3)-113; Grants GM-16197-04; NSF GP-29049)
(USCEE-419; USC-113P19-23) Avail: NTIS HC $5.25

A bibliography is presented for mathematical applications to bioscience research. K.P.D.

N72-30537# Syracuse Univ., N.Y. Dept. of Physics.
THE POSITIVITY CONDITIONS IN GENERAL RELATIVITY
J. N. Goldberg and F. S. Klotz Dec. 1971 16 p refs Sponsored in part by NSF and Aerospace Res. Lab.
Avail: NTIS HC $3.00

The usual treatment of constraints in the canonical formalism was extended to cases where the restrictions on the canonical variables take the form of inequalities. The result is a general prescription for eliminating such restrictions from the canonical formalism. This prescription was applied in order to eliminate the positivity condictions in a model theory and in general relativity. In the case of the model, it was found that elimination of the positivity conditions makes the construction of observables much simpler. In the full theory, however, the spatial constraints introduce complications, and all the calculations were not carried out explicitly. Author

N72-30538# Syracuse Univ., N.Y. Dept. of Physics.
EQUATIONS OF MOTION FOR THE SOURCES OF ASYMPTOTICALLY FLAT SPACES
Robert W. Lind, James Messmer (Pittsburgh Univ.), and Ezra T. Newman (Pittsburgh Univ.) [1972] 33 p refs
(Grants NSF GP-19378; NSF GP-22789)
Avail: NTIS HC $3.75

An exact calculation is presented that leads to the equations of motion of a system subject to no external forces. The system is considered as the source of an asymptotically flat space and that all the relevant physical quantities such as the four-velocity v superscript mu, four-momentum rho superscript mu, angular momentum-center of mass tensor v superscript mu nu (as well as higher moments) are then defined in terms of surface integrals taken at infinity. A subset of the Einstein equations (equivalent to Bondi's supplementary conditions) yields the time evolution equations for these variables. Author

N72-30539# Syracuse Univ., N.Y. Dept. of Physics.
APPLICATIONS OF THE INTERTWINING OPERATORS FOR REPRESENTATIONS OF THE RESTRICTED LORENTZ GROUP
Robert W. Lind, James Messmer (Pittsburgh Univ.), and Ezra T. Newman (Pittsburgh Univ.) Mar. 1972 23 p refs
(Grants NSF GP-19378; NSF GP-22789)
Avail: NTIS HC $3.25

Some properties of the intertwining operations, which carry over certain infinite dimensional, reducible (but not completely reducible) representations of the restricted Lorentz group into finite dimensional (irreducible) represtations are studied. Author

N72-30540*# Syracuse Univ., N.Y. Dept. of Physics.
SHEAR FREE, TWISTING EINSTEIN-MAXWELL METRICS IN THE NEWMAN-PENROSE FORMALISM
Robert W. Lind Jul. 1972 34 p refs Sponsored in part by NASA
(Grant NSF GP-19378)
(NASA-CR-127867) Avail: NTIS HC $3.75 CSCL 12A

The problem of finding algebraically special solutions to the vacuum Einstein-Maxwell equations was investigated using a spin coefficient formalism. The general case in which the degenerate null vectors are not hypersurface orthogonal is reduced to a problem of solving five coupled differential equations that are no longer dependent on the affine parameter along the degenerate null directions. It is shown that the most general regular, shear-free, nonradiating solution to these equations is the Kerr-Newman metric. Author

N72-30541# Syracuse Univ., N.Y.
GLOBAL SPINOR FIELDS IN SPACE-TIME Ph.D. Thesis
Kotik Kai Lee Jun. 1972 26 p refs Supported by NSF
Avail: NTIS HC $3.50

Space-time manifolds are considered that are space- and time-oriented, causal, and possess spinor structures. Three propositions are proved: (1) If a connected, space- and time-oriented manifold is simply connected, then it is noncompact. (2) If such a manifold is simply connected, it admits a spinor structure, which, moreover, is unique. (3) If a compact space- and time-orientable manifold has a first Betti number b sub 1 (M) = 1, then M admits two distinct spinor structures. It is further suggested that in view of the fact that the existence of a spinor structure is related to homotopy properties, space-time manifolds may be classified in terms of their homotopy groups, i = 1, ..., 4. Author

N72-30542# Harvard Univ., Cambridge, Mass.
COMPARATIVE DYNAMICS (SENSITIVITY ANALYSIS) IN OPTIMAL CONTROL THEORY
Hajime Oniki Apr. 1972 46 p refs
(Contract N00014-67-A-0298-0019; NR Proj. 047-004)
(AD-741708; TR-10) Avail: NTIS CSCL 12/1

The paper considers an optimal control problem with a parameter and develops a systematic method for comparative dynamics. A sufficient condition for the optimum solution to be differentiable with respect to the parameter is provided. Formulas for computing the derivative are given in the form of initial-value problems of linear differential equations. Possibility of discontinuous optimal controls is fully taken care of. The derivative of the maximized objective function with respect to the parameter is expressed in a simple form by using the auxiliary variables. An example of the comparative dynamics is given in terms of a model of optimal capital accumulation.
Author (GRA)

N72-30543# Washington Univ., St. Louis, Mo. Control Systems Science and Engineering.
FILTERING AND CONTROL PERFORMANCE BOUNDS WITH IMPLICATIONS ON ASYMPTOTIC SEPARATION
Donald L. Snyder and Ian B. Rhodes 26 Apr. 1972 21 p refs Sponsored in part by NIH

(Contract F44620-69-C-0116; Grant NSF GK-32239; AF Proj. 9749)
(AD-741925; CSSE-735-Rev; AFOSR-72-1046TR) Avail: NTIS CSCL 12/1

Lower bounds are derived on the error covariance in causally filtering from various nonlinear observation formats, including doubly-stochastic Poisson processes. These lead to performance bounds and conditions for asymptotic separation in stochastic control problems. Author (GRA)

N72-30544# George Washington Univ., Washington, D.C.
ALGORITHMIC AND COMPUTATIONAL ASPECTS OF THE USE OF OPTIMIZATION METHODS IN ENGINEERING DESIGN
Garth P. McCormick 13 Apr. 1972 22 p refs
(Contract N00014-67-A-0214)
(AD-742341; Serial-T-263) Avail: NTIS CSCL 12/2

The paper deals with the relationship of recent advances in optimization theory, algorithms, and computation to problems of engineering design. The use of point-based optimality criteria for sensitivity analysis is discussed using as an example the design of a cylindrical torsion bar. The use of branch and bound methods for handling nonconvex programming problems to get around the problem of multiple local solutions is illustrated with a problem of reservoir design. An automatic procedure based on a new language for describing mathematical functions is shown as a way to interface between algebraic descriptions of design problems and computer codes implementing more powerful algorithms. This is illustrated by a problem in the design of a space launch vehicle. The capability of converting any optimization problem to a separable problem--thus facilitating the computerized description of the problem--is illustrated by aspects of the design of a vertical corrugated transverse bulkhead. Finally, comments are made concerning the future relationship between optimal engineering design problems and algorithms for solving them.
Author (GRA)

N72-30545# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
STUDIES IN DIGITAL AUTOMATA Quarterly Progress Report, 1 Dec. 1971 - 29 Feb. 1972
Paul Murrill Feb. 1972 34 p refs
(Contract F44620-68-C-0021; AF Proj. 9769; Proj. Themis)
(AD-740902; AFOSR-72-0920TR) Avail: NTIS CSCL 12/1

The report contains a list of papers and summaries of reports in the fields of automata theory, control theory, process control, computer programming, and automatic control with the uses of mathematical models and computerized simulation. GRA

N72-30546# Texas A&M Univ., College Station. Inst. of Statistics.
NON-CONVEX PROGRAMMING FOR POLYNOMIALS
Essam K. Al-Hussaini and H. O. Hartley Mar. 1972 58 p refs
(Contract N00014-68-A-0140; NR Proj. 047-700)
(AD-741635; TR-36) Avail: NTIS CSCL 12/1

The report develops a numerical solution to the problem of maximizing a polynomial, not necessarily concave, over the closure of a bounded domain in the n-dimensional Euclidean space. As an essential part of this solution algorithms for computing integrals of powers of polynomials are developed. For the general problem of maximizing a function over a region defined by the intersection of non-linear inequalities, a theorem which gives the point of maximum as well as the maximum value of the objective function is stated and proved. Again no assumption on the concavity of the non-linear functions is made.
Author (GRA)

N72-30547# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
THE NUMERICAL OPTIMIZATION OF DISTRIBUTED PARAMETER SYSTEMS BY GRADIENT METHODS
Douglas E. Cornick and Anthony N. Michel Mar. 1972 158 p refs
(Contract N00014-68-A-0162)
(AD-740338; ERI-72072) Avail: NTIS CSCL 12/1

The numerical optimization of distributed parameter systems is considered. In particular the adaptation of the Davidon method, the conjugate gradient method, and the best step steepest descent method to distributed parameters is presented. The class of problems with quadratic cost functionals and linear dynamics is investigated. Penalty functions are used to render constrained problems amenable to these gradient techniques. Also considered is an analysis of the effects of discretization of continuous distributed parameter optimal control problems. Estimates of discretization error bounds are established and a measure of the suboptimality of the numerical solution is presented. Author (GRA)

N72-30230* Harvard Univ., Cambridge, Mass.
LIE ALGEBRAS AND LINEAR DIFFERENTIAL EQUATIONS
Rojer W. Brockett and Abdolhossein Rahimi *In its* Differential Geometric Methods in Control 31 Jul. 1972 p 121-128 refs
(For availability see N72-30224 21-10)
(Grant NSF GS-14152)
CSCL 12A

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N72-30548 Japan Meteorological Agency, Tokyo.
CLIMATIC ATLAS OF JAPAN, VOLUME 1
1971 69 p refs In JAPANESE and ENGLISH Previously announced as N71-73786
Avail: Issuing Activity

Charts are presented for basic meteorological elements such as air temperature, humidity, vapor pressure, precipitation amount, and atmospheric pressure. All charts are printed in multicolors and in large size so that the effect of topography on climate can be seen with ease. Author

N72-30549 Japan Meteorological Agency, Tokyo.
CLIMATIC ATLAS OF JAPAN, VOLUME 2
1972 197 p refs In JAPANESE and ENGLISH
Avail: Issuing Activity

Charts are presented for basic elements such as snow cover, cloud amount, and sunshine, along with diagrams showing the number of days classified by air temperature, precipitation amount, etc. Charts, diagrams, and statistics are also given on typhoon, strong wind, heavy rain, air transmissivity, the beginning date of cherry blossoming, the first date of the appearance of butterflies, etc., as well as the climographs for various parts of Japan. Author

N72-30550*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
INTERHEMISPHERIC COMPARISON OF ATMOSPHERIC CIRCULATION FEATURES AS EVALUATED FROM NIMBUS SATELLITE DATA Annual Report, 1 Jul. 1971 - 30 Jun. 1972
E. R. Reiter, T. H. VonderHaar, J. E. Lovill, R. Adler, S. Srivatsangam, and Alice Fields 30 Jun. 1972 81 p refs
(Grant NGR-06-002-098)
(NASA-CR-127915) Avail: NTIS HC $6.25 CSCL 04B

The report includes a complete analyses of O3 data inferred from Nimbus-3 measurements, a discussion of future areas of study, description of the regression and inversion methods developed to infer atmospheric temperature and tropopause characteristics, as well as the plan to process the satellite data

for a systematic study of the relative circulation differences between Northern and Southern Hemispheres. Author

N72-30551*# Techtran Corp., Glen Burnie, Md.
METEOROLOGICAL FLIGHT CONDITIONS FOR SUPERSONIC AIRCRAFT
I. G. Pchelko, N. V. Peterenko, and G. S. Buldovskiy Washington NASA Jul. 1972 184 p refs Transl. into ENGLISH of the publ. "Meteorologicheskiye Usloviya Poletov Sverkhzvukovykh Samoletov" Leningrad, Hydrometeorol. Press, 1970
(Contract NASw-2037)
(NASA-TT-F-693) Avail: NTIS HC $3.00 CSCL 04B

The composition and structure of the atmosphere are described in terms of the flight medium affecting the performance of aircraft. Emphasis is placed on certain important features of meteorological conditions in the troposphere and stratosphere. Seasonal pecularities of atmospheric circulation in the stratosphere are described. Interaction between stratospheric and atmospheric processes is analyzed. Meteorological phenomena and meteorological elements at all stages of supersonic flight are discussed. The information is of interest to aeronautical meteorologists, and useful to pilots and specialists interested in meteorological flight conditions in the stratosphere. Author

N72-30552# RAND Corp., Santa Monica, Calif.
ENERGY TRANSFORMATION AND REARRANGEMENT CAUSED BY CUMULUS CONVECTION
L. Randall Koenig and Francis W. Murray May 1972 3 p refs Presented at Intern. Conf. on Cloud Phys., London, 21-26 Aug. 1972; sponsored by Intern. Comm. on Cloud Phys.
(P-4832) Avail: NTIS HC $3.00

A numerical model of cumulus convection including warm microphysics was used to examine the production, decay, rearrangement, and flux of energy resulting from growth and decay of small cumulus clouds in initially static environments. The forms of energy examined are static energy (and its individual components: enthalpies of dry air, water vapor, and condensed water; latent heat of water vapor; and potential energy), and kinetic energy. Author

N72-30553# TRW Systems Group, Redondo Beach, Calif.
TROPICAL CYCLONES
Paul Dergarabedian and Francis Fendell May 1972 116 p refs
(Contracts DAHC04-71-C-0025; DAHC04-67-C-0015; ARPA Order 1786)
(TRW-18524-6002-R0-00) Avail: NTIS HC $8.00

The salient observational facts about tropical cyclones and the principal models for the cyclone-scale structure and maintenance of the quasisteady mature stage are described. Analyses relating to maximum swirl speed estimates and to surface frictional layer dynamics and energetics are reviewed. Reservations concerning the frictional inflow layer modeling and the interpretation of temperature measurements are stated in detail. Unresolved questions concerning tropical cyclone intensification are discussed, for transition from depression to hurricane emphasized. Concepts concerning conditional instability of the second kind on the cumulus scale are cited as a probable prerequisite to progress in the theoretical modeling of intensification. Author

N72-30554*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROJECT FOG DROPS. PART 1: INVESTIGATIONS OF WARM FOG PROPERTIES
R. Pilie, W. Eadie, E. J. Mack, C. Rogers, and W. C. Kocmond Washington NASA Aug. 1972 151 p refs
(Contract NASw-2126)
(NASA-CR-2078; RM-3005-M-5-Pt-1) Avail: NTIS HC $3.00 CSCL 04B

A detailed study was made of the micrometeorological and microphysical characteristics of eleven valley fogs occurring near Elmira, New York. Observations were made of temperature, dew point, wind speed and direction, dew deposition, vertical wind velocity, and net radiative flux. In fog, visibility was continuously recorded and periodic measurements were made of liquid water content and drop-size distribution. The observations were initiated in late evening and continued until the time of fog dissipation. The vertical distribution of temperature in the lowest 300 meters and cloud nucleus concentration at several heights were measured from an aircraft before fog nucleus concentrations at several heights were measured from an aircraft before fog formation. A numerical model was developed to investigate the life cycle of radiation fogs. The model predicts the temporal evolution of the vertical distributions of temperature, water vapor, and liquid water as determined by the turbulent transfer of heat and moisture. The model includes the nocturnal cooling of the earth's surface, dew formation, fog drop sedimentation, and the absorption of infrared radiation by fog. Author

N72-30555*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROJECT FOG DROPS. PART 2: LABORATORY INVESTIGATIONS
W. C. Kocmond, E. J. Mack, U. Katz, and R. J. Pilie Washington NASA Jul. 1972 40 p refs
(Contract NASw-2126)
(NASA-CR-2079; RM-3005-M-6-Pt-2) Avail: NTIS HC $3.00 CSCL 04B

Measurements of the total nucleus concentration and cloud condensation nuclei (CCN) were acquired for several conditions representing both high normal and severe pollution levels for the Los Angeles Basin as well as clean filtered air. The data show that in filtered air there is a large photochemically induced increase in the total particle content within a few minutes after starting the lamp. The concentration of CCN remains near zero, until sufficient coagulation and condensation occurs on the smaller Aitken particles. The addition of gaseous pollutants to filtered air results in large increases in the photochemical production of both the cloud and Aitken nucleus concentration. Fogs were also generated under controlled, reproducible conditions in the cloud chamber and seeded with aerosols of various compounds which form monomolecular surface films at air-water interfaces. Visibility characteristics and droplet data were obtained. The data suggest that droplet growth on treated nuclei can be retarded but fog formation was not significantly altered by the chemical seeding. Author

N72-30556# TRW Systems, Redondo Beach, Calif. Science and Technology Div.
TORNADO AND HURRICANE THERMO-HYDRODYNAMICS Final Report
30 Apr. 1971 158 p refs
(Contract NOAA-E22-48-71(N))
Avail: NTIS HC $10.00

Thermohydrodynamic characteristics of tornadoes and tropical hurricanes are discussed, and a model of tropical cyclones is developed. The mature-stage quasi-steady structure, the intensification stage, and the decay of a tropical hurricane are described, including the energetics of the surface frictional layer and the stored throughput supply of the mature stage. Recent work on tornado boundary layers is reviewed. Analyses of tornado properties include properties of mature vortical storms, a method for rapid estimation of maximum tangential wind speed, estimation of maximum wind speed in tornadoes, and a characteristic time scale of strong thermals. N.E.N.

N72-30557# Committee on Public Works (U. S. Senate).
PROGRESS IN THE PREVENTION AND CONTROL OF AIR POLLUTION Annual Report of the Administrator of the Environmental Protection Agency to the Congress of the United States
Washington GPO Mar. 1972 22 p ref Presented to the Comm. on Public Works, 92d Congr., 2d Sess., 24 Mar. 1972 Prepared by the Environ. Protection Agency
(S-Doc-92-66) Avail: US Capitol, Senate Document Room

A prototype automobile engine that meets EPA's 1976 emission standards in initial tests was developed. Proposed

emission standards were published for three hazardous air pollutants. New source performance standards were promulgated for five types of industrial sources of air pollution. National ambient air quality standards were published for six common classes of pollutants. Guidelines to assist states in developing air quality standards plans were also published. Regulations for judging 1975 and 1976 model cars for compliance with the Clean Air Act were presented. Portions of 21 regional air pollution control plans for sulfur oxides and particulate matter were approved. Author

N72-30558# Committee on Public Works (U. S. Senate).
THE ECONOMICS OF CLEAN AIR Annual Report of the Administrator of the Environmental Protection Agency to the Congress of the United States
Washington GPO Mar. 1972 244 p refs Presented to the Comm. on Public Works, 92d Congr., 2d Sess., 24 Mar. 1972 Prepared by the Environ. Protection Agency
(S-Doc-92-67) Avail: SOD $1.00

A report is presented on the prospective costs and impacts of governmental and private efforts to carry out the provisions of the Clean Air Amendment of 1970. The benefits of air pollution control and other abatement strategies are considered. National and regional governmental programs are discussed. Mobile sources of air pollution are pinpointed, including emissions (nature and source, and emission levels with and without standards), control technology (conventional engine control, unconventional power sources, and new vehicle testing and factory surveillance), and costs of compliance with the Clean Air Act (types and sources of costs, unit costs of control on new vehicles, and national costs through 1977). K.P.D.

N72-30559# Committee on Public Works (U. S. Senate).
REPORT TO THE PRESIDENT AND CONGRESS ON NOISE
Washington GPO Feb. 1972 472 p refs Presented by the Administrator of EPA to Comm. on Public Works, 92d Congr., 2d Sess., 1 Mar. 1972 Prepared by Environ. Protection Agency
(S-Doc-92-63) Avail: SOD $1.75

The effects of noise on living things and property, noise sources and their current environmental impact, and control technology and estimates for the future are considered. The following topics are discussed: auditory, sociological, physiological, and psychological effects; effects of noise on wildlife; effects of sonic boom and other impulsive noise on property; physical effects of noise on structures and property; community noise; transportation systems, devices powered by internal combustion engines; noise from industrial plants; construction equipment and operations; household and building noise; transportation industry programs; noise reduction for industrial plants; construction and appliance industry efforts; laws and regulatory schemes for noise abatement; government, industry, professional, and voluntary association programs; and assessement of noise concern in other nations. K.P.D.

N72-30560# Istituto di Fisica Dell Atmosfera, Rome (Italy).
RELATION BETWEEN URBAN MICROMETEOROLOGY AND ATMOSPHERIC POLLUTION OVER CITIES (METHODOLOGY OF URBAN POLLUTION CHARACTERIZATION) [RAPPORTI FRA MICROMETEOROLOGIA CITTADINA ED INQUINAMENTO ATMOSFERICO URBANO (SCHEMA DI CARATTERIZZAZIONE DELL'INQUINAMENTO CITTADINO)]
L. Mammarella Dec. 1970 30 p refs In ITALIAN
(IFA-TR-34) Avail: NTIS HC $3.50

A preliminary research plan on atmospheric pollution in selected areas of the city of Rome, to be implemented in 1971, is presented. Sampling and analysis techniques, and related instrumentation, are described. The use of tracers is advised for following the circulation and accumulation of contaminants by microclimatic events. These and further studies should help to characterize standard techniques for studying the reciprocal effects of atmospheric pollution and climatology in urban and industrial areas. ESRO

N72-30561# Istituto di Fisica Dell Atmosfera, Rome (Italy).
ATMOSPHERIC STABILITY AND AIR POLLUTION (PROPOSAL OF A SIMPLE METHOD FOR EVALUATING AIR STABILITY CONDITIONS) [LA STABILITA ATMOSFERICA E GLI INQUINAMENTI AERODIFFUSI (PROPOSTA DI UN METODO SEMPLICE DI APPREZZAMENTO DELLE CONDIZIONI DI STABILITA DELL'ARIA)]
Luigi Mammarella Dec. 1970 15 p refs In ITALIAN
(IFA-RDP-35) Avail: NTIS HC $3.00

A simple set of parameters sufficient for defining meteorological conditions that will influence diffusion or concentration of air pollutants is described. ESRO

N72-30562# Istituto di Fisica Dell Atmosfera, Rome (Italy).
RAPID EVALUATION OF DIFFERENTIAL SAMPLING (CONCENTRATION COMPARISON COUNTING METHOD) [L'APPREZZAMENTO RAPIDO DI UN CAMPIONAMENTO DIFFERENZIALE (METODICA DI CONTEGGIO PER COMPARAZIONE DI CONCENTRAZIONE)]
Luigi Mammarella Jan. 1971 20 p refs In ITALIAN
(IFA-RDP-37) Avail: NTIS HC $3.00

A method for counting aerosol particles and comparing concentration is described, which is based on cascade impactors used for sampling air from polluted urban and industrial areas. Cascade impactors, originally developed for biological aerosol sampling (pollen, spores and microorganisms) provide a simple and rapid technique for granulometry measurements. ESRO

N72-30563# Istituto di Fisica Dell Atmosfera, Rome (Italy).
PRELIMINARY RESEARCH ON RADIOACTIVE AIR POLLUTION OBSERVED IN ITALY AFTER THREE NUCLEAR EXPLOSIONS ON 14 OCTOBER 1970 [PRIME INDAGINI SULL'INQUINAMENTO RADIOATTIVO DELL'ARIA RILEVATO IN ITALIA DOPO LE TRE ESPLOSIONI NUCLEARI DEL 14 OTTOBRE 1970]
B. Pavesi and E. Dietrich Feb. 1971 72 p refs In ITALIAN
Prepared jointly with Aeron. Nil. Ital.
(IFA-RDP-38) Avail: NTIS HC $5.75

Measurement methods and characteristics of atmospheric radioactive contamination over Italy between mid-October and November 1970 are discussed. Analyses of the results of measurements show that the first pollution wave, observed on 18 and 19 October, which is due to slow decay radioactive substances, could have been produced by accidental fallout from American or Russian experiments. The second wave, observed on 25 October, seems to be due to the thermonuclear explosion in the Sinkiang desert on 14 October. Studies are at present being carried out on the hypothesis of an accumulation of dust during winter in the polar stratosphere. ESRO

N72-30564# Istituto di Fisica Dell Atmosfera, Rome (Italy).
MEASUREMENT OF ATMOSPHERIC CARBON DIOXIDE IN SOME ITALIAN AREAS DURING 1964, 1965, AND 1966 [CONSIDERAZIONI E RISULTATI DELLE MISURE DI CO2 ATMOSFERICO ESEGUITE IN ALCUNE LOCALITA ITALIANE NEGLI ANNI 1964, 1965 E 1966]
A. DeMaio, M. Moretti, and E. Sansone Oct. 1970 42 p refs In ITALIAN; ENGLISH summary
(IFA-SR-31) Avail: NTIS HC $4.25

Considerations and results of atmospheric carbon dioxide measurements carried out in several Italian regions during 1964, 1965, and 1966 are presented. ESRO

N72-30565# Istituto di Fisica Dell Atmosfera, Rome (Italy).
ATMOSPHERIC POLLUTION STUDY USING MATHEMATICAL MODELS (CONTROLLED INVESTIGATION PROPOSAL) [LO STUDIO DEGLI INQUINAMENTI ATMOSFERICI MEDIANTE MODELLI MATEMATICI (PROPOSTA DI UN'INDAGINE CONTROLLATA)]
Luigi Mammarella Jan. 1971 31 p refs In ITALIAN
(IFA-SR-33) Avail: NTIS HC $3.75

Several formulae suitable for correlating parameters which influence the atmospheric propagation of polluting effluents are discussed and practical examples given. These mathematical models require experimental verification before general use.
ESRO

N72-30566# Istituto di Fisica Dell Atmosfera, Rome (Italy).
ATMOSPHERIC POLLUTION IN ITALY [L'INQUINAMENTO ATMOSFERICO IN ITALIA]
L. Mammarella Jun. 1971 18 p refs In ITALIAN; ENGLISH summary Presented at 11th Congr. of the Italian Acad. of Biol. and Human Sciences
(IFA-RDP-42) Avail: NTIS HC $3.00

Results of a study on air pollution problems in Italy, which included emission of pollutants, meteorological conditions of different regions, and resulting damage, are summarized. Annual damage due to pollution in 1968 is estimated to be at least 560 million dollars. A reduction of pollution was observed due to the application of a new pollution control law. ESRO

N72-30567# Istituto di Fisica Dell Atmosfera, Rome (Italy).
METEOROLOGY AND HUMAN ENVIRONMENT: TYPICAL CASES OF RADIOACTIVE POLLUTION IN THE ATMOSPHERE [METEOROLOGIA ED AMBIENTE UMANO: CASI TIPICI DI INQUINAMENTO RADIOATTIVO DELL'ATMOSFERA]
Benvenuto Pavesi Mar. 1971 13 p refs In ITALIAN Presented at the 11th World Meteorological Meeting, Rome, 23 Mar. 1971 Prepared jointly with Aeron. Mil. Ital.
(IFA-RDP-41) Avail: NTIS HC $3.00

Long and short term studies of radioactive dust contamination over Italy as a result of distant thermonuclear explosions and meteorological events, are described. ESRO

N72-30568# World Meteorological Organization, Geneva (Switzerland).
REPORT OF THE THIRD SESSION OF THE TROPICAL EXPERIMENT BOARD Global Atmospheric Research Programme
May 1971 30 p Conf. held in Geneva, Apr. 1972 Prepared jointly with Intern. Council of Sci. Unions
(GARP-Spec-Rept-6) Avail: NTIS HC $3.50

A brief progress report and the national contributions to GATE are given followed by an assessment of overall resources in relation to the project plans, implementation and schedules. The project planning of the experiment is reviewed and an appendix on the GATE oceanography program is included.
ESRO

N72-30569# Max-Planck-Institut fuer Stromungsforschung, Gottingen (West Germany).
SUBTROPICAL JET STREAM DYNAMICS Thesis - Goettingen Univ. [ZUR DYNAMIK SUBTROPISCHER STRAHLSTROEME]
Hermann Leinemann 1972 108 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft
(Rept-4/1972) Avail: NTIS HC $7.50

Studies of three winter jet streams over North America are used to investigate the origin of the high kinetic energy in subtropic jet stream maxima. The evaluation of radiosonde data leads to the result that the Euler equations of frictionless hydrodynamics are not sufficient to describe this flow. The strong velocity variations in the catchment area and the delta of jet streams lead to the conclusion that besides power produced by or against the pressure field, the effect of impulse transports is added on a subsynoptic scale. The force components, not contained in the Euler equations, are determined parallel and perpendicular to the flow. Supplementary to the analysis of high tropospheric flow fields, the development of characteristic structures of the temperature field is investigated in connection with the jet stream maxima. ESRO

N72-30570# World Meteorological Organization, Geneva (Switzerland).
EXPERIMENT DESIGN PROPOSAL FOR THE GARP ATLANTIC TROPICAL EXPERIMENT Global atmospheric research programme
Jun. 1972 199 p refs Prepared jointly with Intern. Council of Sci. Unions
(GATE-1) Avail: NTIS HC $12.00

The design and implementation of the GARP Atlantic Tropical Experiment (GATE) is presented, together with the general scientific objectives and the global implications of the experiment. The program and other research activities are considered and some aspects (cloud clusters, tropical waves, tropical convection) are examined in detail. The observational strategy and network is described and general information on the data management, communication systems, support facilities, and functional structure is given. A bibliography is included.
ESRO

N72-30571# France. Direction de la Meteorologie Nationale, Paris.
UPPER WIND OVER FRENCH POLYNESIA [LE VENT EN ALTITUDE AU-DESSUS DE LA POLYNESIE FRANCAISE]
A. dHauteserre Apr. 1972 55 p refs In FRENCH
(MONO-85) Avail: NTIS HC $4.75

The seasonal wind variations recorded over French Polynesian Islands from 1964 to 1970 using radiotheodolites or radar are reported. An analysis is given of mean resultant winds for standard pressure levels of 850, 700, 300, 200, 100, 70, 50, 30, and 20 millibars. ESRO

N72-30572# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Jun. 1972 [OBSERVATIONS CLIMATOLOGIQUES BULLETIN MENSUEL, JUIN 1972]
R. Sneyers Jun. 1972 17 p In FRENCH and DUTCH
Avail: NTIS HC $3.00

Meteorological parameters observed at different Belgian weather stations during June 1972 are given. ESRO

N72-30573# Institut Royal Meteorologique de Belgique, Brussels.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Sep. 1971 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, SEPTEMBRE 1971]
1972 32 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Synoptic measurements made at different weather stations in September 1971 are reported. ESRO

N72-30574# Institut Royal Meteorologique de Belgique, Brussels.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Aug. 1971 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, AOUT 1971]
1972 32 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Synoptic measurements made at different Belgian weather stations in August 1971 are reported. ESRO

N72-30575# Institut Royal Meteorologique de Belgique, Brussels.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Jul. 1971 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, JUILLET 1971]
1972 32 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Synoptic measurements made at different Belgian weather stations in July 1971 are reported. ESRO

N72-30576# Environmental Technical Applications Center (Air Force), Washington, D.C.
A SELECTED ANNOTATED BIBLIOGRAPHY OF ENVIRON-

MENTAL STUDIES OF ITALY, 1952-1971
Larry N. Huff, Comp., Vincent J. Creasi, Comp., and Hilda J. Snelling, Comp. May 1972 38 p refs
(AD-741806; USAFETAC-TN-72-5) Avail: NTIS CSCL 04/2

The selected bibliography includes references to 12 recurring publications of environmental studies of Italy and a discussion of their contents. A total of 103 references are contained in the listings which include area, subject, and author indices.
Author (GRA)

N72-30577# Naval Oceanographic Office, Washington, D.C.
ON AREAL RELIABILITY OF CERTAIN CLIMATIC CHARACTERISTICS OF THE OCEAN IN THE NORTHERN PART OF THE PACIFIC OCEAN
V. V. Filippov and A. S. Kaganskii 1972 23 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklimatologii (Moscow), no. 46, 1967 p 210-222
(AD-742317; NOO-Trans-534) Avail: NTIS CSCL 04/2

The authors discuss the optimal size, shape and position of geometrical figures on the basis of data from which one can obtain the most areally reliable meteorological data and make most reliable meteorological predictions. The authors also discuss the dzgree of importance and specific effects of certain factors, mention the data available to them and discusses their line of reasoning.
Author (GRA)

N72-30578# Naval Weapons Center, China Lake, Calif.
PROJECT FOGGY CLOUD 3, PHASE 1
Tommy L. Wright, Richard S. Clark, and Pierre St.-Amand Apr. 1972 78 p refs
(AD-742081; NWC-TP-5297) Avail: NTIS CSCL 04/2

Foggy Cloud III, Phase I is part of a continuing series of experiments concerning the modification and dispersal of warm fog and stratus clouds. Tests were conducted at the Arcata-Eureka Airport, Humboldt County, Calif. from 27 July to 24 October 1970, using fixed-wing aircraft as delivery vehicles. The seeding agents were (1) a solution of ammonium nitrate, urea, and water developed during Foggy Cloud I, and (2) water. Of the 19 seeding tests, 17 showed some response to seeding. The results of seeding seven fogs classified as steady-state were completely successful, with ceilings and visibilities improved sufficiently to permit normal flight operations.
Author (GRA)

N72-30579# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
DIAGNOSTIC STUDY OF THE PLANETARY BOUNDARY LAYER OVER THE OCEANS
William M. Gray Feb. 1972 99 p refs
(Contract N62306-69-C-0261; Grant NSF GA-19937)
(AD-741717; Paper-179) Avail: NTIS CSCL 04/2

A statistical survey of the wind veering in the lowest two kilometers is made for the oceans of the Northern Hemisphere. The data sample consists of over 100,000 pibal and rawin soundings. This includes observations made from ships in the 0-70 degrees latitude belt and observations at atolls and small islands in the 5-35 degrees latitude belt. The wind veering is stratified by latitude, season, wind direction and wind speed.
Author (GRA)

N72-30580# Digital Programming Services, Inc., Waltham, Mass.
RESEARCH IN NUMERICAL ANALYSIS TECHNIQUES FOR FOG MODEL SIMULATION Final Scientific Report, 13 Jan. 1969 - 31 Sep. 1971
Russell C. Serbagi 15 Nov. 1971 48 p refs
(Contract F19628-69-C-0178; AF Proj. 7605)
(AD-740967; AFCRL-71-0581) Avail: NTIS CSCL 04/2

A computer model is given for the numerical solution of the partial differential equations governing the transport and condensation processes of clouds. The models considered include two dimensional warm fog seeding, one dimensional cumulus cloud formation, and three dimensional warm fog modification by external heat sources. The finite difference techniques used and the stability criteria are discussed. A series of computer programs, data reduction techniques, and data analysis procedures are developed to recover pertinent data from various recording media. The meteorological data collected is reduced into a usable form such that computer studies relative to the growth, structure, and modification techniques of convective clouds can be made.
Author (GRA)

N72-30581# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBULENCE IN FREE ATOMOSPHERE
N. K. Vinnichenko, N. Z. Pinus, S. M. Shmeter, and G. N. Shur 11 Feb. 1972 393 p refs Transl. into ENGLISH of the book "Turbul. v Svbodnoi Atmosfere" Leningrad, 1968 p 1-336
(AF Proj. 682E)
(AD-741491; FTD-MT-24-939-71) Avail: NTIS CSCL 04/2

The report is concerned mainly with outlining the results of experimental investigations. Along with these, the authors discuss those questions in the theory of turbulence without which physical analysis of the presented data is difficult. The book also contains a description of instruments for measuring various parameters of turbulence in the free atmosphere.
Author (GRA)

N72-30582# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 11602 LANCE, MISSILE NO. 2119, ROUND NO. 152 EST, 16 MARCH 1972 Meteorological Data Report
Mar. 1972 73 p
(AD-740155; DR-700) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11602 Lance, Missile Number 2119, Round Number 152 EST, are presented in tabular form.
Author (GRA)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N72-30583*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
DYNAMIC TESTING OF A SINGLE-DEGREE-OF-FREEDOM STRAPDOWN GYROSCOPE
Charles B. Lory, Julius Feldman, and John S. Sinkiewicz, Jr. Oct. 1971 104 p refs
(Contract NAS12-2033; MIT Proj. 55-34010)
(NASA-CR-123804; E-2618) Avail: NTIS HC $7.25 CSCL 17G

Test methods and results are presented for the equivalent average input rate of a single-degree-of-freedom gyroscope operated both open loop and with a ternary-logic pulse-torque-to-balance loop during multiaxis angular oscillation. For the open-loop tests, good agreement was obtained with theoretical results. Two-axis testing was performed for oscillations about the Input-Output axes, the Input-Spin axes, and the Spin-Output axes. These tests run in the torque-to-balance mode revealed significant departures from open-loop results in the induced drift rate. An analysis is developed explaining much of the closed-loop data presented. Test data for the gryoscope in a ternary torque-to-balance loop with constant input rates is presented. The tests demonstrate that the instrument rate linearity does not change with interrogation frequency from 3,600 to 14,400 Hz if the torque coil is tuned to offer a resistive load to the current switch. Analysis cited shows that gyroscope lag compensation eliminates multiple pulsing and other equivalent forms of degraded resolution in a wide variety of quantizing loops. This result is test verified for the ternary delta-modulator loop.
Author

N72-30584*# TRW Systems Group, Redondo Beach, Calif.
DESIGN CONCEPT (MILESTONE 2) FOR SPACE VEHICLE ENTRY AND LANDING NAVIGATION PROGRAMS
L. S. Diamant 5 Mar. 1971 28 p Sponsored by NASA
(NASA-CR-127912; TRW-5522.7-71-47) Avail: NTIS HC $3.50 CSCL 17G

Detailed specifications and functional flow diagrams for space vehicle entry and landing navigation programs are reported. General design criteria, overall functions, and interfaces between the following three programs are considered: external observations program, noisy observations program, and navigation analysis program. G.G.

N72-30585*# Texas Univ., Austin. Applied Mechanics Research Lab.
NAVIGATION STRATEGY AND FILTER DESIGN FOR SOLAR ELECTRIC MISSIONS
B. D. Tapley and Hamilton Hagar, Jr. May 1972 156 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-127860; AMRL-1040) Avail: NTIS HC $10.00 CSCL 22A

Methods which have been proposed to improve the navigation accuracy for the low-thrust space vehicle include modifications to the standard Sequential- and Batch-type orbit determination procedures and the use of inertial measuring units (IMU) which measures directly the acceleration applied to the vehicle. The navigation accuracy obtained using one of the more promising modifications to the orbit determination procedures is compared with a combined IMU-Standard. The unknown accelerations are approximated as both first-order and second-order Gauss-Markov processes. The comparison is based on numerical results obtained in a study of the navigation requirements of a numerically simulated 152-day low-thrust mission to the asteroid Eros. The results obtained in the simulation indicate that the DMC algorithm will yield a significant improvement over the navigation accuracies achieved with previous estimation algorithms. In addition, the DMC algorithms will yield better navigation accuracies than the IMU-Standard Orbit Determination algorithm, except for extremely precise IMU measurements, i.e., gyroplatform alignment $< .01$ deg and accelerometer signal-to-noise ratio $> .07$. Unless these accuracies are achieved, the IMU navigation accuracies are generally unacceptable. Author

N72-30586*# Stanford Univ., Calif. Dept. of Applied Mechanics.
IMPROVED NAVIGATION BY COMBINING VOR/DME INFORMATION WITH AIR OR INERTIAL DATA
John C. Bobick and Arthur E. Bryson, Jr. May 1972 156 p refs Sponsored in part by NSF
(Grant NGL-05-020-007; Contract F33615-72-C-1297)
(NASA-CR-124826; SUDAAR-442) Avail: NTIS HC $10.00 CSCL 17G

The improvement was determined in navigational accuracy obtainable by combining VOR/DME information (from one or two stations) with air data (airspeed and heading) or with data from an inertial navigation system (INS) by means of a maximum-likelihood filter. It was found that the addition of air data to the information from one VOR/DME station reduces the RMS position error by a factor of about 2, whereas the addition of inertial data from a low-quality INS reduces the RMS position error by a factor of about 3. The use of information from two VOR/DME stations with air or inertial data yields large factors of improvement in RMS position accuracy over the use of a single VOR/DME station, roughly 15 to 20 for the air-data case and 25 to 35 for the inertial-data case. As far as position accuracy is concerned, at most one VOR station need be used. When continuously updating an INS with VOR/DME information, the use of a high-quality INS (0.01 deg/hr gyro drift) instead of a low-quality INS (1.0 deg/hr gyro drift) does not substantially improve position accuracy. Author

N72-30587# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PARALLEL APPROACH SURVEILLANCE
J. B. Allen and E. J. Denlinger 14 Aug. 1972 57 p refs
(Contract DOT-FA72WAI-261; FAA Proj. 034-241-012)
(ATC-13; FAA-RD-72-77) Avail: NTIS HC $5.00

The requirements imposed on a surveillance system for supporting independent approaches to closely spaced parallel runways are presented. Based on a proposed procedure for monitoring aircraft approach paths and controlling deviations from proper approach paths, the required spacing between runway centerlines is derived as a function of surveillance system characteristics and other parameters. Potential trade-offs between the surveillance system characteristics are then investigated to determine whether the discrete address beacon (DABS) sensor might be utilized for position measurement and/or communication in such a surveillance system. The results indicate that the required runway spacing is more sensitive to delays and data update intervals than to position measurement accuracies, and that, if DABS is to perform the communication function in the system, it should probably be used for position measurement as well. Author

N72-30588# Joint Publications Research Service, Arlington, Va.
EFFECT OF PERTURBATIONS AND VIBRATIONS ON GYROINSTRUMENTS
D. P. Muzlov, V. P. Fedorov, and M. A. Sergeyev 9 Aug. 1972 18 p refs Transl into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), no. 5, 1972 18 p
(JPRS-56723) Avail: NTIS HC $3.00

On the basis of the transition to the mercury cushion mechanical analog, a mathematical description of such features of its motion in a basic resonance regime is given, as disruptions and jumps of amplitude of the plane oscillations, and also the appearance of oscillations of a plane normal to the direction of vibration. Three values of frequencies are determined at which resonances are possible. It is demonstrated that at the most probable frequency of external perturbations a force oscillation is superimposed on the basic precession motion, which hampers taking the reading from the sensory element. These oscillations may be decreased by means of damping basically with respect to the coordinate characterizing the translational motion. Author

N72-30589# National Aviation Facilities Experimental Center, Atlantic City, N.J.
AN EVALUATION OF POTENTIAL REFLECTION PROBLEMS WHEN USING THE NAS MODEL 3D DISPLAY IN THE VERTICAL POSITION IN AIR ROUTE TRAFFIC CONTROL CENTERS Interim Report, Dec. 1971 - May 1972
Lee E. Paul Sep. 1972 26 p
(FAA-RD-72-60) Avail: NTIS HC $3.50

A production version of a plan view display was taken to traffic control centers and operated in a sector radar position. A typical digital sector display was simulated through the use of a Raytheon 704 computer and tape drive. A total of 166 controllers observed the display and filled out questionnaires on it, 118 seeing the display with the safety shield in place, 48 seeing it with shield removed. Ambient light level measurements were made at each of the centers. A small percentage of the controllers stated that reflections were a serious problem when the safety shield was in place. With the shield removed, a significantly smaller number indicated a reflection problem. There were very large differences in the ambient light levels at the centers. Author

N72-30590# Bordeaux Univ. (France).
STUDY ON STABILISATION OF A SATELLITE DESIGNED FOR FOURIER-TRANSFORM INFRARED SPECTROSCOPY Ph.D. Thesis [ETUDE DE LA STABILISATION D'UN SATELLITE DESTINE A LA SPECTROSCOPIE INFRAROUGE PAR TRANSFORMATION DE FOURIER]
J. Flandrois Paris ESRO May 1972 110 p refs In FRENCH; ENGLISH summary
(ESRO-SN-119) Avail: NTIS HC $7.50

The stabilization system of an astronomical satellite designed to carry out Fourier-transform infrared spectroscopy is studied. A recapitulation of the results already obtained demonstrates the

advantages of this method and enables the telescope pointing accuracy requirements to be stated. After a study of the attitude reference system and of the first maneuvers of the satellite, the advantages of, and problems raised by, control moment gyros in attitude stabilization are shown. A steering law for two Euler-suspension gyroscopes with two degrees of freedom is developed. By means of simulations on analog computer it has been possible to verify the theoretical calculations on stabilfty, to optimize the steering law of the gimbal motors and to give the performance of the stabilization system. The complete analytical equations of the motion of the gyroscopes, their reaction torques on the satellite and the steering law, are also given.
Author (ESRO)

N72-30591# Ohio Univ., Athens. Dept. of Electrical Engineering.
ALL WEATHER, LOW LEVEL NAVIGATION AND IMPLEMENTATION OF A ONE-WAY RANGING, RANGE-RANGE NAVIGATION SYSTEM Semiannual Report, Apr. - Oct. 1971
Feb. 1972 65 p refs
(Contracts DAAB07-68-C-0084; DAAB07-71-c-0156)
(AD-741813; ECOM-0084-4; SAR-4) Avail: NTIS CSCL 17/7

A third-generation RF receiver for navigation uses was designed using digitally-tuned superheterodyne techniques. This approach allows more flexibility and stability in tuning and reduced harmonic and crossmodulation distortion providing greater spectral purity of the output waveform. Four approaches are under investigation leading to an optimized state-of-the-art dedicated digital processor whose architecture is structured specifically for navigation tasks. A rate-gyro stabilized flight director was also designed, simulated, and implemented onboard the DC-3 Flying Laboratory and successfully provided anticipatory command information to the pilot for a stored-route flight plan. Flight experiments with the breadboard system have demonstrated position location accuracies of better than 200 feet, for one standard deviation, for 11 independent flights. Investigation of autocorrelation signal processing techniques for elimination of the onboard clock requirement shows that delay-line stabilities of the order of plus or minus 100 picoseconds for range errors of plus or minus 10 feet are required and presently not technically feasible.
Author (GRA)

N72-30592# Department of Transportation, Washington, D.C.
DEPARTMENT OF TRANSPORTATION NATIONAL PLAN FOR NAVIGATION
Apr. 1972 35 p
(AD-741944) Avail: NTIS CSCL 17/7

A plan for the operation, development and implementation of existing and possible future navigation systems for civil aviation and maritime requirements is presented. Areas of air and marine commonality are discussed with the objective of minimizing the number of radio navigation aids. Specific Federal Aviation Administration and Coast Guard programs for research and development of navigation systems, and an operating plan into the 1980's are described. Special emphasis is placed on long distance air navigation and high seas marine navigation. Typical of navigation systems considered are Inertial, Loran, Omega and Satellite. New statements of policy in regard to long distance navigation aids are proposed to replace the current U. S. policy adopted by the Air Coordinating Committee on 23 December 1958. User charges based on Public Law 91-250 are summarized.
Author (GRA)

N72-30593# Avco Corp., Wilmington, Mass. Systems Div.
SKYWAY PATHS BY DOPPLER FREQUENCY ANALYSIS (SKYDOP), PHASE 1
David G. Detert, Alan H. Katz, and Andrew S. Weeks Griffiss AFB, N. Y. RADC Mar. 1972 170 p refs
(Contract F30602-70-C-0123)
(AD-741807; RADC-TR-72-62) Avail: NTIS CSCL 17/3

An evaluation of a new experimental direction finding technique known as Doppler monopulse is described. An evaluation of experimental field data is made concerning the percent of time the technique would be effective with respect to ionospheric propagation. Consideration is given to the effects of signal modulation.
Author (GRA)

N72-30594# Coast Guard, Washington, D.C. Applied Sciences Div.
FOLLOW-THE-WIRE MARINE AID TO NAVIGATION SYSTEM: REPORT ON AN INITIAL DEMONSTRATION INSTALLATION Final Report
James A. McIntosh May 1972 40 p refs
(CG Proj. 726450)
(AD-742320) Avail: NTIS CSCL 09/1

A need exists for a short range, high accuracy marine navigation system for use in ice-covered rivers and channels. One potential solution consists of an energized cable laid on a channel bottom precisely on the desired trackline, and sensing coils and display equipment mounted on the ship to determine and indicate the direction of the cable from the ship. In particular, voltages induced in the sensing coils by the cable's magnetic field are used to generate (by the Lissajous technique) a narrow ellipse on the face of a cathode ray tube. The tilt angle of the major axis of this ellipse is indicative of the cable location with respect to the ship.
Author (GRA)

N72-30595# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
OPTIMAL PARAMETERS OF A SATELLITE GRAVITATIONAL STABILIZATION SYSTEM WITH GYRO-DAMPING
V. A. Sarychev and K. V. Lukanin 2 Dec. 1971 52 p refs Transl. into ENGLISH of Inst. Prikl.-Mat. preprint no. 46, Moscow, 1971
(Contract N00017-72-C-4401)
(AD-740893; APL-CLB-3-T-649) Avail: NTIS CSCL 22/1

The paper investigates the transient attitude performance of a gravity gradient satellite. Damping is provided by a pair of two-degree-of-freedom gyroscopes. First the dynamical equations of motion are presented and used to obtain the characteristic equation. The parameters which optimize the spacecraft's transient attitude performance are determined from the solution of the characteristic equation. The results are then specialized to the case of an axisymmetric satellite and to the case of an external disturbance due to orbital eccentricity.
Author (GRA)

N72-30596# Coast Guard, Washington, D.C. Applied Sciences Div.
TESTS OF AIRCRAFT NAVIGATION FOR SMALL AREA MAPPING USING MINIMUM LOCAL AIDS TO NAVIGATION Final Report
James A. McIntosh Apr. 1972 34 p refs Tests held at Natl. Aviation Facilities Exptl. Center, Atlantic City, 9 Sep. 1971
(Contract DOT-CG-20738-B; MIPR Z-70099-2-21107; CG Proj. 726417)
(AD-740607) Avail: NTIS CSCL 17/7

A U. S. Coast Guard HC-130B aircraft was flown on a parallel track pattern while within range of a high accuracy tracking radar, and the navigational performance of the aircraft while using only certain specified aids was observed. The aids used were LF and UHF radiobeacons, the aircraft's Doppler radar, a transponder for the aircraft's search radar, and an inertial guidance system.
Author (GRA)

N72-30597# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PRECISION AIRCRAFT NAVIGATION BASED ON LORAN-C AND DIGITAL ALTIMETRY
L. F. Fehlner Jan. 1972 72 p refs
(Contract N00017-72-C-4401)
(AD-740894; APL-TG-1184) Avail: NTIS CSCL 17/7

The report describes a system that can provide precision aircraft navigation based on loran-C and digital barometric altimetry. The system is expected to be capable of fulfilling the critical accuracy requirements of the terminal area as well as

serving the needs of area navigation. A digital barometric altimetry technique is described, which has sufficient accuracy to provide the third dimension for all phases of aircraft flight. Further, several auxiliary functions are described that are made practicable by high-accuracy positioning. These are: on-board determination of the point to release an object for free fall to the ground, a built-in approach and departure system, and automatic direction finding. Author (GRA)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N72-30598*# Gulf General Atomic, San Diego, Calif.
FABRICATION OF (U, Zr) C-FUELED/TUNGSTEN-CLAD SPECIMENS FOR IRRADIATION IN THE PLUM BROOK REACTOR FACILITY
12 Jul. 1972 39 p refs
(Contract NAS3-13471; Proj. 6154)
(NASA-CR-120945; GULF-GA-A12121) Avail: NTIS HC $4.00 CSCL 18J

Fuel samples, 90UC - 10 ZrC, and chemically vapor deposited tungsten fuel cups were fabricated for the study of the long term dimensional stability and compatibility of the carbide-tungsten fuel-cladding systems under irradiation. These fuel samples and fuel cups were assembled into the fuel pins of two capsules, designated as V-2E and V-2F, for irradiation in NASA Plum Brook Reactor Facility at a fission power density of 172 watts/c.c. and a miximum cladding temperature of 1823 K. Fabrication methods and characteristics of the fuel samples and fuel cups prepared are described. Author

N72-30599*# Techtran Corp., Glen Burnie, Md.
EXPERIMENTAL INVESTIGATION OF THE CREEP BUCKLING BEHAVIOR OF THIN WALLED PIPES MADE OF HEAT RESISTANT MATERIALS Ph.D. Thesis - Karlsruhe Univ.
Herbert Kaupa Washington NASA Aug. 1972 81 p refs Transl. into ENGLISH of "Experimentelle Untersuchung des Kriechbeulverhaltens Duennwandiger Rohre aus Hochwarmfesten Werkstoffen" Karlsruhe Univ., Nov. 1970 72 p
(Contract NASw-2037)
(NASA-TT-F-14160) Avail: NTIS HC $6.25 CSCL 20K

The creep buckling tendencies of thin-walled tubes exposed to high external pressures at elevated temperatures are discussed. Special consideration is given to the fuel element cladding tubes in steam or gas cooled fast breeder reactors. Theories of creep buckling and evaluations of experiments dealing with the phenomena of creep buckling are presented. The test equipment and procedures used in conducting creep buckling experiments are reported. Author

N72-30600*# NUS Corp., Rockville, Md.
EMITTED RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE RADIOISOTOPE THERMOELECTRIC GENERATORS
P. J. Gingo and J. J. Steyn Mar. 1971 133 p refs
(Contract NAS5-11359)
(NASA-CR-122414; NUS-772) Avail: NTIS HC $8.75 CSCL 10C

The nuclear and emitted radiation characteristics of the radioisotope elements and impurities in commercial grade plutonium dioxide are presented in detail. The development of the methods of analysis are presented. Radioisotope thermoelectric generators (RTG) of 1575, 3468 and 5679 thermal watts are characterized with respect to neutron and gamma photon source strength as well as spatial and number flux distribution. The results are presented as a function of detector position and light element contamination concentration for fuel age ranging from 'fresh' to 18 years. The data may be used to obtain results for given O-18 and Pu-236 concentrations. The neutron and gamma photon flux and dose calculations compare favorably with reported experimental values for SNAP-27. Author

N72-30601*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIMINIODE PERFORMANCE DATA WITH AN ASTAR-811C EMITTER AND A NIOBIUM - 1-PERCENT-ZIRCONIUM COLLECTOR
Arthur L. Smith, Richard B. Lancashire, Eugene J. Manista, and James F. Morris Washington Sep. 1972 16 p refs
(NASA-TM-X-2587; E-6962) Avail: NTIS HC $3.00 CSCL 18J

The performance of a fixed-space planar miniature diode (diminiode) with a guarded collector has been mapped using a computerized data acquisition facility. The electrode materials consisted of a tantalum alloy emitter and a Nb-1Zr collector; the electrode gap was 0.254 mm. Author

N72-30602# Los Alamos Scientific Lab., N.Mex.
FIRST WALL MATERIALS PROBLEMS IN A PULSED FUSION REACTOR
W. V. Green and F. L. Ribe 1972 9 p refs Presented at Fusion First-wall Materials Meeting, Germantown, Md., 27 Jan. 1972
(Contract W-7405-eng-36)
(LA-DC-72-125; Conf-720112-1) Avail: NTIS

The conclusions of the panel are given and the properties of a theta-pinch pulsed reactor as presently visualized are summarized. For the case of a shock-heated z pinch the first wall problems would be similar. NSA

N72-30603# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material und Festkoerperforschung.
TREATMENT OF THE MECHANICAL AND THERMAL RELATIONS OF FUEL RODS IN SATURN 1
H. Kaempf, H. Elbel, and F. Depisch Nov. 1971 45 p refs In GERMAN; ENGLISH summary Presented at 1st Intern. Conf. on Struct. Mech. in Reactor Technol., Berlin, 20-24 Sep. 1971
(KFK-1477) Avail: AEC Depository Libraries

In Saturn 1 the time history of a fuel pin concerning the radial distribution of temperature, stress, porosity and geometry changes is calculated. The operating fuel pin conditions such as linear rod power, outside temperature of the cladding and outside pressure are time dependent input data, so steady state and cyclic conditions are taken into account. The following material phenomena essential for the mechanical and thermal behavior are interconnected in Saturn 1: creep of fuel and clad, swelling of fuel and clad, thermal expansion, crack formation, fission gas release, porosity migration, and heat transfer fuel-clad. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N72-30604# Wyle Labs., Inc., El Segundo, Calif.
COMMUNITY NOISE
31 Dec. 1971 204 p refs
(Contract EPA-68-04-0046)
(NTID300.3) Avail: SOD $1.75

The overall noise pollution problem which is associated with

outdoor noise in a community is considered. Provided is a quantitative framework for understanding the nature of the outdoor noise environment and the reaction of people and community to its various aspects. Author

N72-30605# Goodfriend (L. S.) Associates, Cedar Knolls, N.J.
NOISE FROM INDUSTRIAL PLANTS
31 Dec. 1971 333 p refs
(EPA-68-04-0044)
(NTID300.2) Avail: NTIS HC $18.75

Typical industrial plants located in urban, suburban, and rural communities were surveyed and their noise sources were identified. The plants were glass manufacturing, oil refinery, power generating, automobile assemble, and can manufacturing. The noise at communities adjacent to these plants was recorded for five minute sampling periods during two days and nights of normal operation and during weekends. Only the automobile assembly and glass manufacturing plants are principal sources of community noise; elsewhere noise from surface transportation on superhighways and traffic near the plants either predominates or contributes equally with industrial plants. The impact of industrial plant noise on the work and the community environments, and attitudes towards noise legislation are discussed. Noise control programs for industrial plants are described, and the noise abatement technology is assessed.
N.E.N.

N72-30606# Environmental Protection Agency, Washington, D.C.
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FROM REPORT TO THE PRESIDENT AND CONGRESS ON NOISE
31 Dec. 1971 18 p refs
(NRC500.1) Avail: SOD $0.30

General observations, conclusions, and the future program are briefly summarized from the study on noise sources, noise pollution, and noise abatement. It is pointed out that noise effects are difficult to define and evaluate and available information on typical exposures is sparse. Noise control technology and possible changes in the noise problem to the year 2000, methodologies for noise measurement and evaluation, and economic implications of noise and noise abatement are mentioned. Recommendations for achieving noise reduction over the next 5 to 10 years are outlined. N.E.N.

N72-30607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMISSION OF SOUND FROM AXISYMMETRIC TURBULENCE CONVECTED BY A MEAN FLOW WITH APPLICATION TO JET NOISE
Marvin E. Goldstein and Burt M. Rosenbaum Washington Sep. 1972 42 p refs
(NASA-TN-D-6939; E-6844) Avail: NTIS HC $3.00 CSCL 20A

A model, based on Lighthill's theory, for predicting aerodynamic noise from a turbulent shear flow is developed. This model is a generalization of the one developed by Ribner. Unlike Ribner's model, it does not require that the turbulent correlations factor into space and time-dependent parts. It replaces his assumption of isotropic. turbulence by the more realistic one of axisymmetric turbulence. The implications of the model for jet noise are discussed. Author

N72-30608# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE ACOUSTICS OF FLOW DUCTS
P. E. Doak 29 Feb. 1972 14 p refs Conf. held in Southampton, Engl., 11-14 Jan. 1972
(ISVR-TR-55) Avail: NTIS HC $3.00

The papers presented highlight particular problems, uncertainties, and conclusions for acoustic attenuation, impedance, and propagation and the theoretical problem of flow duct acoustics. ESRO

N72-30609# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
MEASUREMENT TECHNIQUE USING ELECTROMAGNETIC SUSPENSION Ph.D. Thesis - Brunswick Univ. [EIN BETRAG ZUR MESSTECHNISCHEN ANWENDUNG DER AKTIVEN ELEKTROMAGNETISCHEN LAGERUNG]
Wolfgang Klimek Mar. 1972 190 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-30) Avail: NTIS HC $11.50; DFVLR, Porz 41 DM

The measurement of accelerations which react on an electromagnetically suspended body can be carried out by measuring the magnetism causing currents. The quality of measurement depends on the dynamic and stationary behavior of the control loop necessary for the position stabilization. A high cut-off frequency, a good strength for acceleration, and a high accuracy of measurement are of primary interest for investigation of the behavior of the control loop. The mutual coupling of different control loops and the possibilities of efficient decoupling are shown for a radially electro-magnetically suspended axle-shaft. The drive power required for rotating this shaft is found by means of material characteristics. The theoretical considerations are confirmed by experiments. Author (ESRO)

N72-30610# Naval Research Lab., Washington, D.C.
A FORTRAN PROGRAM FOR COMPUTING THE POWER RESPONSE OF A HYDROPHONE ARRAY TO A SPHERICAL WAVE AND PLOTTING IT AS AN ISOMETRIC SURFACE
Leon P. LaLumiere, Jr. 17 Apr. 1972 32 p
(NRL Proj. S01-39)
(AD-742063; NRL-7393) Avail: NTIS CSCL 17/1

PLOTBEAM is a Fortran program designed to simulate the power response of an arbitrary, focused hydrophone array to an incoming spherical wave whose source is at some predetermined distances. It is used with a three-dimensional plot routine to display output values as a response surface. The program is useful in the study of response dependence on such factors as focal direction and distance, delays due to hydrophone positioning, signal frequency, and hydrophone weighting. Author (GRA)

N72-30611# Pennsylvania State Univ., University Park. Ordnance Research Lab.
AN ACOUSTIC ARRAY MODEL FOR THE COMPUTATION OF THE ROTATIONAL NOISE OF A LIFTING ROTOR
John A. Macaluso 1 Feb. 1971 37 p refs
(Contract N00017-70-C-1407; NR Proj. 215-015)
(AD-740816; TR-1-71) Avail: NTIS CSCL 20/1

A description is given of the development and corroboration of a simplified computational model for the prediction of the radiated rotational noise of a lifting rotor or propeller. The method is based on a solution of the concentrated force-excited wave equation and the identification of the terms in this solution with annular distributions of monopole sources of specified phase and amplitude. The computational algorithms developed from this mathematical model provide a rapid means for determining the amplitude and phase of the radiated sound field. They are particularly well suited for providing a description of rotor noise characteristics, which can be used as input to computer programs designed to calculate the rotor noise field in the presence of boundaries. Author (GRA)

N72-30612# Naval Postgraduate School, Monterey, Calif.
SOUND DISPERSION AND PHASE FLUCTUATIONS IN THE UPPER OCEAN Ph.D. Thesis
Jurgen Rautmann Dec. 1971 91 p refs
(AD-741148) Avail: NTIS CSCL 20/1

In-Situ measurements of the speed of sound in the upper ocean have revealed the existence of significant dispersion and large fluctuations over the frequency range 25-80 kHz. The near-surface values of c ranges from -6 M/sec to -3 M/sec relative to the bubble-free value, with a maximum estimated error of 0.5 M/sec. It was possible to identify bubbles of surface radius centered around 54 microns down to 4.3 meter

depth as well as a population centered around 124 microns (at 4.3 M) found at all depths. The speed fluctuation showed near-Gaussian probability density functions except at the dispersion center frequencies. The standard deviation of the speed varied from 0.27 M/sec for 58.0 kHz to 0.52 M/sec at 69.6 kHz. Author (GRA)

N72-30613# Naval Postgraduate School, Monterey, Calif.
AMPLITUDE MODULATION OF AN ACOUSTIC WAVE PROPAGATING NEAR THE OCEAN SURFACE M.S. Thesis
Wilton Jeremain Smith, Jr. Dec. 1971 88 p refs
(AD-741108) Avail: NTIS CSCL 20/1

Sixty kHz CW sound was propagated parallel to and near the ocean surface adjacent to an array of four thermistors, a salinometer, a sound velocimeter, a turbulent velocity probe, and a wave-height probe in order to investigate the statistics and environmental causes of amplitude modulation. The temporal variations of the sound amplitude were studied during four twenty-minute runs over a range of 2 meters at varying depths from near the surface to 14 meters during sea-state one conditions in water of 16 meters-depth. Analysis indicated mean percentage amplitude modulation of approximately 5% with a variance of approximately 10-3. Author (GRA)

N72-30614# Army Foreign Science and Technology Center, Charlottesville, Va.
SURVEY OF MODERN PHOTORANGEFINDERS
G. I. Borodulin 20 Apr. 1972 27 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 7, 1970
(AD-741255; FSTC-HT-23-441-72) Avail: NTIS CSCL 20/6

The aim of the survey is to familiarize a wide range of field geodicists with the main operating specifications of photo-rangefinders and with their capabilities in geodetic work.
Author (GRA)

N72-30615# Naval Research Lab., Washington, D.C.
ECHO SIGNALS FROM ELASTIC OBJECTS IN WATER SURVEY AND BIBLIOGRAPHY
N. D. Veksler Apr. 1972 40 p refs Transl. into ENGLISH from Akad. Nauk Estonskoi SSR, Inst. Kibernetiki (USSR)
(AD-741609; NRL-Trans-1251) Avail: NTIS CSCL 17/1

A review of the literature on investigations of echo pulses from elastic objects in water, published mainly during the last ten years, is given in this survey. The survey contains four parts: (1) The classical theory of scattering; (2) Circumferential and creeping wave theory; (3) Related problems; and (4) Conclusions. Author (GRA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-30616 National Standard Reference Data System.
ATOMIC ENERGY LEVELS AS DERIVED FROM THE ANALYSES OF OPTICAL SPECTRA. VOLUME 1: THE SPECTRA OF HYDROGEN, DEUTERIUM, TRITIUM, HELIUM, LITHIUM, BERYLLIUM, BORON, CARBON, NITROGEN, OXYGEN, FLUORINE, NEON, SODIUM, MAGNESIUM, ALUMINUM, SILICON, PHOSPHORUS, SULFUR, CHLORINE, ARGON, POTASSIUM, CALCIUM, SCANDIUM, TITANIUM, AND VANADIUM
Charlotte E. Moore Dec. 1971 360 p refs Revised
(NSRDS-NBS-35-Vol-1; LC-75-609945) Avail: SOD $5.00 as C13.48:35/V.I

A critical compilation of atomic energy level data is presented on the spectra of hydrogen, deuterium, tritium, helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, argon, potassium, calcium, scandium, titanium, and vanadium. Author

N72-30617 National Standard Reference Data System.
ATOMIC ENERGY LEVELS AS DERIVED FROM THE ANALYSES OF OPTICAL SPECTRA. VOLUME 3: THE SPECTRA OF MOLYBDENUM, TECHNETIUM, RUTHENIUM, RHODIUM, PALLADIUM, SILVER, CADMIUM, INDIUM, TIN, ANTIMONY, TELLURIUM, IODINE, XENON, CESIUM, BARIUM, LANTHANUM-HAFNIUM, TANTALUM, TUNGSTEN, RHENIUM, OSMIUM, IRIDIUM, PLATINUM, GOLD, MERCURY, THALLIUM, LEAD, BISMUTH, POLONIUM, RADON, RADIUM, AND ACTINIUM
Charlotte E. Moore Dec. 1971 283 p refs Revised
(NSRDS-NBS-35-Vol-3; LC-75-609945) Avail: SOD $4.50 as c13.48:35/ V.III

A critical compilation of atomic energy level data is presented on the spectra of molybdenum, technetium, ruthenium, rhodium, palladium, silver, cadmium, indium, tin, antimony, tellurium, iodine, xenon, cesium, barium, lanthanum, hafnium, tantalum, tungsten, rhenium, osmium, iridium, platinum, gold, mercury, thallium, lead, bismuth, polonium, radon, radium, and actinium. Author

N72-30618*# Teledyne Brown Engineering, Huntsville, Ala. Science and Engineering.
NONELASTIC NUCLEAR REACTIONS AND ACCOMPANYING GAMMA RADIATION Final Report
R. Snow, H. R. Rosner, M. C. George, and J. D. Hayes Sep. 1971 237 p refs
(Contract NAS8-25534)
(NASA-CR-121023; SE-SSL-1407) Avail: NTIS HC $14.00 CSCL 18H

Several aspects of nonelastic nuclear reactions which proceed through the formation of a compound nucleus are dealt with. The full statistical model and the partial statistical model are described and computer programs based on these models are presented along with operating instructions and input and output for sample problems. A theoretical development of the expression for the reaction cross section for the hybrid case which involves a combination of the continuum aspects of the full statistical model with the discrete level aspects of the partial statistical model is presented. Cross sections for level excitation and gamma production by neutron inelastic scattering from the nuclei Al-27, Fe-56, Si-28, and Pb-208 are calculated and compared with available experimental data. Author

N72-30619*# Texas Univ., Dallas.
STUDY OF EXCITATION TRANSFER IN FLOWING HELIUM AFTERGLOW PUMPED WITH A TUNEABLE DYE LASER. 2: MEASUREMENT OF THE RATE COEFFICIENT FOR THE ROTATIONAL RELAXATION OF He2(3p (3 Pi g))
C. B. Collins and B. W. Johnson [1972] 19 p refs
(Grant NGL-44-004-001)
(NASA-CR-127347; SP-72-006-2) Avail: NTIS HC $3.00 CSCL 20H

The rotational relaxation of the He2(3p(3pi g)) state is examined by optically pumping a flowing helium afterglow with a tuneable dye laser. The population of the J = 8 rotational state is enhanced by optically saturating the R sub 7 component of the transition connecting this state with the metastable He2(2s (3 Sigma u +)) molecular state. From the lifetime and yield of the Q sub 7 component, the rate coefficient for the rotational relaxation via the forbidden delta J = 1 channel is determined to be of the order of 2 x 10 to the minus 11th power cm3/sec. It is found that this represents about half of the total rate of rotational relaxation in this state. Author

N72-30620*# Pittsburgh Univ., Pa. Dept. of Physics.
MEASUREMENTS OF RECOMBINATION OF ELECTRONS WITH H3O(PLUS)-(H2O)n SERIES IONS
M. T. Leu, Manfred A. Biondi, and R. Johnsen Jul. 1972 30 p refs Submitted for publication
(Grants NGR-39-011-002; DA-ARO(D)-31-124-70-G34)
(NASA-CR-127820; SRCC-176; APP-31) Avail: NTIS HC $3.50 CSCL 20H

Recombination coefficients of electrons with ions of the hydrated hydronium ion series (H3O(+))(H2O)n, where n = 0, 1, 2, 3, 4, 5, 6, were determined with a microwave afterglow/mass spectrometer apparatus. Afterglow measurements of electron density decays in helium-water vapor mixtures are correlated with the decay of mass-identified ion currents to the wall of the microwave cavity. By varying the temperature of the gas and the partial pressure of the water vapor in the mixture, different groups of hydronium series ions are made to dominate the afterglow. Author

N72-30621*# Houston Univ., Tex.
SUPPORTING STUDIES FOR THE CORONAGRAPH CONTAMINATION EXPERIMENT Final Report, 1 Sep. 1968 - 28 Feb. 1971
Natalie S. Kovar 28 Feb. 1971 35 p refs
(Contract NAS9-8869)
(NASA-CR-115762) Avail: NTIS HC $3.75 CSCL 20H

Calculations of Mie scattering functions involved individual as well as mixed scattering of particles. In particular, computations were completed for a 15A particle and for particles subjected to incident light of ultraviolet wavelengths. Calculations of contaminant atmospheres for Gemini, Apollo, and Skylab considered leakage rates for the respective vehicles and the mass column density of the atmospheres surrounding them. Atmospheres for these vehicles have been computed for a uniform particle size distribution, and for a particle size distribution in which size varied. G.G.

N72-30622# Northeastern Univ., Boston, Mass. Dept. of Physics.
LIGHT CONE ALGEBRA, FIELD CURRENT IDENTITY AND DEEP INELASTIC SCATTERING
R. Arnowitt, M. H. Friedman, and P. Nath Jul. 1972 34 p refs Sponsored in part by NSF
(NUB-2149) Avail: NTIS HC $3.75 CSCL 20H

The full content of the Fritzsch-Gell-Mann light cone algebra is reproduced for deep inelastic lepton-nucleon scattering using currents given by the field current identity. These currents are modified by dilaton clothing from the usual low energy vector dominance form by the principles of scale invariance to possess a scale dimension three. The calculation is performed by the technique of an effective Lagrangian to be used to first nonvanishing order, and the form of the interactions needed to maintain the light cone algebra are determined. The usual quark-parton results are explicitly obtained. The Callan-Gross sum rule is examined and shown to be consistent with the above results. Author

N72-30623# Illinois Univ., Urbana.
THE CONVERGENCE OF THE SUM RULES FOR CLUSTER FUNCTIONS IN A phi-CUBED LADDER MODEL
Fritz Bopp Aug. 1972 17 p refs
(Grant NSF GP-25303)
(ILL-(TH)-72-9) Avail: NTIS HC $3.00

The convergence of the series in the sum rules of Campbell and Chang for cluster functions was investigated numerically for the phi cubed ladder model. It was found that in this model these sum rules diverge for a sufficiently large value of the coupling constant for which the Pomeranchukon-Regge trajectory goes through alpha(0) = 1. Author

N72-30624# Northeastern Univ., Boston, Mass. Physics Dept.
SCALING CONDITIONS AND APPLICATIONS
M. H. Friedman, P. Nath, and R. Arnowitt Jul. 1972 15 p refs Sponsored in part by NSF
(NUB-2148) Avail: NTIS HC $3.00

A principle is discussed in which the constraints on coupling structures due to the breakdown of scale invariance enter symmetrically with the constraints due to the Poincare algebra. Applications at low energy to meson decays, at intermediate energy to positron + electron annihilation into four charged pions, and at high energy to light cone commutators are given. Author

N72-30625# Illinois Univ., Urbana. Physics Dept.
A DESCRIPTION OF THE A1 MESON AS A POLE
Jon Wright Aug. 1972 12 p refs
(Grant NSF GP-25303)
(ILL-(TH)-72-8) Avail: NTIS HC $3.00

An analysis of the A1 meson is presented in which it appears as a pole of the scattering amplitude in a coupled two or three channel system. The important new ingredient is the inclusion of the S meson, with the S-pion system coupling to the rho-pion system. The pole is partially shielded from the physical region by the cut beginning at the S-pi threshold. All of the important experimental features of A1 production are reproduced by the model. Author

N72-30626*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ULTRAHIGH ENERGY PHOTONS, ELECTRONS, AND NEUTRINOS, THE MICROWAVE BACKGROUND, AND THE UNIVERSAL COSMIC-RAY HYPOTHESIS
F. W. Stecker Sep. 1972 21 p refs Submitted for publication
(NASA-TM-X-66007; X-641-72-319) Avail: NTIS HC $3.25 CSCL 20H

The production of ultrahigh energy photons, electrons and neutrinos as the decay products of pions produced in photomeson interactions between cosmic ray nucleons and the blackbody microwave background is discussed in terms of the resultant energy spectra of these particles. Simple asymptotic formulas are given for calculating the ultrahigh energy photon spectrum predicted for the universal cosmic ray hypothesis and the resulting spectra are compared with those obtained previously by numerical means using a different propagation equation for the photons. Approximate analytic solutions for the photon spectra are given in terms of simple power-law energy functions and slowly varying logarithmic functions. Author

N72-30627# Maryland Univ., College Park. Center for Theoretical Physics.
FINITE ENERGY SUM RULES ON HYPERBOLAS Ph.D. Thesis
James C. Sandusky Jun. 1972 102 p refs
(Grant NSF GU-2061)
(TR-72-127) Avail: NTIS HC $7.25

Dispersion relations and finite energy sum rules (FESR's) on hyperbolas were derived in the real Mandelstam plane which are asymptotic to lines of fixed s and u, together with an ellipse on which s and u are complex. These FESR's on hyperbolas are applied to backward and near-backward pion-nucleon scattering and are used to extract information about the first eight partial waves for the reaction nucleon antinucleon yields pion pion. Concerning this reaction, zeroes were found above threshold for almost all partial waves; also strong evidence for background or daughters in the lower ones (J < or = 3). For J = 4 and 5, daughters are less evident. Application to Regge residue parameters for P prime and rho suggest these residues turn over at large, positive t but do not change sign. The values favor rho-f exchange degeneracy for the spin flip case and a simple form of exchange degeneracy breaking for the nonflip case. Values for the P prime residues indicate the A(+) amplitude does not satisfy and unsubtracted dispersion relation. Author

N72-30628# Maryland Univ., College Park. Center for Theoretical Physics.
THE LIGHT CONE AND COMPOSITENESS

Patrizio Vinciarelli Jul. 1972 13 p refs
(Grant NSFGU-2061)
(TR-73-019) Avail: NTIS HC $3.00

A light cone analysis is presented for the large momentum transfer limit of inclusive form factors at constant missing mass and for its connection with the Bjorken limit. Testable predictions are made and, with the help of intuitive arguments, an interpretation is offered for known features of the electro-production data. Author

N72-30629# Texas Univ., Austin. Center for Particle Theory.
SOME ASTROPHYSICAL IMPLICATIONS OF SECOND-ORDER EFFECTS IN THE V-A THEORY OF WEAK INTERACTIONS
A. B. Lopez-Cepero and G. Maiella Mar. 1972 31 p refs
(Contract AT(40-1)-3992)
(ORO-3992-65; CPT-115) Avail: NTIS

The process electron + positron yields neutrino + antineutrino and the extent to which second order terms contribute to the first order effects are investigated. A treatment is given for the second order terms in the light of the possible nonexistence of the first order process. Other processes contributing to neutrino emission rates and possible modification due to the second order term are mentioned. The most important conclusion on astronomical evidence is the inadequacy of second order and higher effects to account for observations should the diagonal coupling process be strictly forbidden. It is noted that an area in which second order and higher terms have an effect is at temperature greatly in excess of 10 to the 10th power degree K which are found in the presupernova collapse of a stellar core and the initial expansion phase of the primal universe. NSA

N72-30630# Ohio State Univ., Columbus. Van de Graaff Accelerator Laboratory.
NUCLEAR PHYSICS RESEARCH WITH A 5.5 MeV VAN de GRAAFF ACCELERATOR Annual Report, 1 May 1971 - 30 Apr. 1972
Jul. 1972 150 p refs
(Grant NSFGP-10763)
(VDG-008) Avail: NTIS HC $9.50

A brief summary of the on-going research program, abstracts of publications, and reports on technical developments are presented. The research program covers a wide range of problems in nuclear structure and reaction processes. The areas of interest include polarization studies, particle-gamma and gamma-gamma correlation measurements, charged-particle radiative capture experiments, nuclear lifetime measurements, and isobaric analog resonance investigations. New studies were started in sub-Coulomb stripping reactions, and in total cross section determinations for nuclear astrophysics information. Author

N72-30631# Utah Univ., Salt Lake City. Dept. of Physics.
MEASUREMENT OF THE LOCAL PRODUCTION OF MUONS UNDERGROUND
J. W. Elbert, J. W. Keuffel, and Julia A. Thompson [1972] 11 p refs Sponsored by NSF
Avail: NTIS HC $3.00

The rate of stopping muons at a depth of 145,000 g/sq cm was measured with a view to checking the anomalously high rate observed by the Turin group. Muons produced locally could be separately identified with a large spark counter array. Their rate agrees with expectation based on muon production of hadronic cascades in the rock. The Turin result cannot be reconciled with this one if the excess stopping muons are produced by high energy muons. Author

N72-30632# Los Alamos Scientific Lab., N.Mex.
ENVIRONMENTAL MONITORING IN THE VICINITY OF THE LOS ALAMOS SCIENTIFIC LABORATORY, JANUARY THROUGH JUNE 1971
Joseph E. Herceg, comp. Jan. 1972 44 p refs
(Contract W-7405-eng-36)
(LA-4871) Avail: NTIS

A description is given of the environmental monitoring program in effect at the University of California Los Alamos Scientific Laboratory during the first half of calendar year 1971. Results of programs designed to monitor radiation levels including the atmosphere, local surface and ground waters, sediments and soils are presented. These measurements are used to make estimates of the dose commitments due to plutonium and tritium concentrations in air. The boundaries of the laboratory site, the programs associated with various laboratory technical areas, geologic, climatologic, and economic characteristics of the Los Alamos area, and laboratory procedures used for the analysis of samples are described. Author (NSA)

N72-30633# Rome Univ. (Italy).
TEMPERATURE DEPENDENCE OF THE POLARITON DISPERSION AND DAMPING IN GaP. AN APPLICATION OF THE NONLINEAR SPECTROSCOPY IN THE K VECTOR-SPACE
F. DeMartini and J. Leroy (Mons Univ., Belgium) 1 Jul. 1971 11 p Presented at 6th Quantum Electronics Conf., Kyoto, Sep. 1970
(Ist. di Fisica.)
(Conf-700977-1; Note-325) Avail: AEC Depository Libraries

The two photon nonlinear spectroscopy in the momentum-space of the elementary excitations in solids that exhibit a large group-velocity has been introduced and first applied to the study of the dispersion of the phonon-polaritons in the III-V semiconductor GaP. The results of an experiment are reported in which the study of the temperature (T) dependence of the optical response of the crystal in the polariton region leads to quantitative information on the behavior of the damping processes in the crystal. Author

N72-30634# Sandia Labs., Albuquerque, N.Mex.
RADIATION EFFECTS IN ELECTROLUMINESCENT DIODES
C. E. Barnes [1971] 10 p refs Sponsored by AEC
(SC-R-722617) Avail: NTIS

Following a brief discussion of the operating characteristics of light emitting diodes (LED's), radiation effects in these devices are reviewed. Recent results on neutron damage effects in SiC LED's are also presented. Based on this review, criteria are developed for radiation insensitivity of LED's. Author (NSA)

N72-30635# Battelle-Northwest, Richland, Wash.
ISOTOPE DEVELOPMENT PROGRAMS Quarterly Report, Nov. 1971 - Jan. 1972
J. H. Jarrett, comp. Feb. 1972 20 p
(Contract AT(45-1)-1830)
(BNWL-1308-9) Avail: NTIS

Research results are reported on low cost Cs and Sr sources, and uses of purified fission product Xe, Rh, Pd, Ru, and Tc. Development of radiographic methods using Cf-252 is discussed along with advanced sources, circulatory support systems, and nuclear techniques for seabed exploration. NSA

N72-30636# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
TOWARD A THEORY OF THE NONLINEAR INTERACTION OF ION-ACOUSTIC WAVES WITH ELECTRONS
V. V. Dolgopolov 1971 25 p refs In RUSSIAN
(KHFTI-71-9) Avail: AEC Depository Libraries

Where the ratio of the energy density of the ion-acoustic oscillations with chaotic phases to the thermal electron energy density is sufficiently less than the square root of the ratio of the electron mass to the ion mass, the nonlinear correction to the linear increment is small in comparison to the linear increment. In the reverse case, the theory of weak nonlinearity and the linear theory are not applicable. Author (NSA)

N72-30637# United Kingdom Atomic Energy Authority, Harwell (England).
ION IMPLANTATION Bibliography
R. Morgan and K. R. Greenhalgh Feb. 1972 94 p refs
(AERE-Bib-176; HL-72/335) Avail: AEC Depository Libraries; UK £2

An attempt is made to cover all literature on ion implantation. Abstracts are given where the title is not self-explanatory, and indexes are provided. The abstracts are arranged under the following subject categories: General papers and reviews; machines and ion sources; physical measurements (including electrical and optical properties); chemical effects of ion implantation; lattice location of implanted ions; lattice disorder and radiation damage caused by ion implantation; range measurement and distribution of implanted ions; channeling behavior during ion implantation; and applications in the development of semiconductor devices. NSA

N72-30638# Technische Hochschule Aachen (West Germany). Physikalisches Inst.
FOCUSING OF NEUTRINO PARENTS BY ELLIPTICAL LENSES
H. Faissner, F. J. Hasert, J. VonKrogh, and W. Thome 1972 32 p refs
(PITHA-59) Avail: AEC Depository Libraries

Current sheets with the shape of a rotational ellipsoid behave as lenses for particles passing at small angles to the symmetry axis. Their focal length is proportional to the particle momentum p. This is a big advantage by comparison with a symmetric quadrupole doublet, whose focal length goes with p squared. Elliptical lenses can be combined into lens systems, using the standard methods of geometrical optics. Neutrino spectra for 300 GeV primary energy were computed for a two lens systems. By varying distances and currents one can produce either a wideband beam comparable to that of a magnetic horn, or a medium band beam of variable energy, or a flat high pass beam. Author (NSA)

N72-30639# Fom-Instituut voor Plasmafysica, Jutphaas (Netherlands).
APPROXIMATE CROSS SECTIONS AND RATE COEFFICIENTS FOR IONIZATION, EXCITATION AND RECOMBINATION OF HYDROGENIC IONS AND ATOMS
R. Mewe Jul. 1970 15 p refs Sponsored in part by Neth. Organ. for Pure Sci. Res. (ZWO) and EURATOM
(Rept-70-61) Avail: NTIS HC $3.00

The cross sections and rate coefficients for inelastic collisions, between electrons and hydrogenic ions or atoms, are approximated by analytical expressions for a Maxwellian electron energy distribution. Author (ESRO)

N72-30640# Rome Univ. (Italy). Inst. of Physics.
PION ELECTROPRODUCTION AT THRESHOLD
G. Benfatto, F. Nicolo, and G. C. Rossi 29 Mar. 1972 33 p refs
(Nota-Interna-268) Avail: NTIS HC $3.75

A method for the calculation of the axial nucleon form factor, and the electromagnetic pion form factor at theshold is discussed. The theoretical ingredients are: gauge invariance, low energy theorems and t-fixed dispersion relations. The errors involved in the unavoidable approximations are also discussed. Author (ESRO)

N72-30641# Rome Univ. (Italy). Inst. of Physics.
PHENOMENOLOGICAL ANALYSIS OF SINGLE PION PHOTOPRODUCTION ON NEUTRON IN THE REGION OF P11, D13, AND S11 PION-NUCLEON RESONANCES [ANALISI FENOMENOLOGICA DELLA FOTOPRODUZIONE SINGOLA DI PIONI SU NEUTRONE NELLA REGIONE DELLE RISONANZE PIONE-NUCLEONE P11, D13, S11]
A. Proia and F. Sebastiani 17 Mar. 1972 34 p refs In ITALIAN; ENGLISH summary
(Nota-Interna-363) Avail: NTIS HC $3.75

Some data on pion photoproduction on neutrons in the second resonance region are analyzed using the generalized isobaric model of CDM. The I = 3/2 multipole amplitudes were used to fit the data as well as data from the reaction gamma neutron yields proton negative pions giving two solutions. Furthermore, a new solution was obtained by imposing small imaginary parts of B (background term) and including in the fit only data from the reaction gamma neutron yields proton negative pion. It is shown that both of the two free solutions and the constrained one show large electromagnetic coupling of the isobaric nucleon state P 11 in the channel neutron gamma. ESRO

N72-30642# Rome Univ. (Italy). Inst. of Physics.
A REPRESENTATION OF DIRECT PRODUCT OF SU(3) AND SU(3) CHIRAL ALGEBRA FOR BARYONS
F. Buccella, F. Nicolo, and A. Pugliese 6 Apr. 1972 18 p refs
(Nota-Interna-369) Avail: NTIS HC $3.00

A mixing operator U(Z') for baryons is presented which transforms the SU(6) axial charges into a more realistic set. The (56 direct sum 70, any L) SU(6) direct product O(3) representations to obtain a consistent result, are considered. The octet chiral wave function comes out in good agreement with experimental data and the coupling constants between the (56, L = 0) and any other representation with arbitrary L correspond exactly in a dual sense to the exchange in the t-channel of a tensor nonet and a vector octet. The explicit form of the sq m operator is given. Author (ESRO)

N72-30643# Rome Univ. (Italy). Inst. of Physics.
HIGH ENERGY MEASUREMENTS OF TOTAL CROSS SECTIONS ON PROTON, BY DETECTING VERY LOW ENERGY NEUTRONS
S. Dangelo, P. Monacelli, and F. Sebastiani 7 Apr. 1972 5 p refs
(Nota-Interna-370) Avail: NTIS HC $3.00

The measurement of total cross section in reaction a + p yields anything can be carried out by using a deuterium target and detecting the spectator neutron of the reaction a + d yields (n) spectator + anything. The measurement of the total cross section at extremely high energies can be carried out using a very low energy neutron counter. A neutron detector which includes a plastic scintillator counter and a D2 target for detecting neutrons from 60 to 160 MeV/c, is described and its performance characteristics discussed. ESRO

N72-30644# European Space Research Inst., Frascati (Italy).
HARTREE-FOCK CALCULATIONS OF THE MgI SPECTRUM IN THE EXTREME ULTRAVIOLET
M. W. D. Mansfield and J. P. Connerade [1972] 14 p refs Submitted for publication
Avail: NTIS HC $3.00

Hartree-Fock calculations have been performed for the seven configurations: 2p5 3s2 4s, 2p5 3s2 3d, 2p5 3s2 5s, 2p5 3s2 4d, 2p5 3s 3p2, 2p5 3p2 3d, and 2p5 3p2 4s in Mg I. The predicted levels are compared with previous observations. Agreement is generally good and new identifications are proposed. Author (ESRO)

N72-30645# Missouri Univ., Rolla. Dept. of Physics.
CROSS SECTION FOR PHOTOIONIZATION OF EXCITED CESIUM ATOMS Annual Technical Report, 1 Mar. 1971 - 29 Feb. 1972
Kaare J. Nygaard and Robert E. Hebner, Jr. 31 Mar. 1972 64 p refs
(Contract N00014-69-C-0271; NR Proj. 099-390)
(AD-741222; TR-3) Avail: NTIS CSCL 07/4

A new method for obtaining the cross section for photoionization of photoexcited cesium is presented. The salient feature of this experiment is to use three crossed beams, i.e., two light beams intersecting a beam of cesium atoms. The

cross section is determined by counting the ions produced. The excitation light sources used in obtaining this cross section were rf resonance lamps or GaAs lasers. The ions were extracted from the interaction region and detected with a channel electron multiplier. Author (GRA)

N72-30646# Naval Weapons Evaluation Facility, Albuquerque, N.Mex.
AIR TRANSPORT CALCULATIONS USING THE LASL-NWEF AIR FLUX TAPE AND THE NWEF COMPUTER PROGRAM - CDR
J. E. Campbell and H. A. Sandmeter 10 Apr. 1972 101 p refs
(AD-741180; NWEF-1090) Avail: NTIS CSCL 18/8

The recent availability of coupled neutron/gamma, multigroup, cross-section sets has prompted the production of a neutron-gamma air flux tape similar to the neutron air flux tape reported previously. The air flux data consists of complete transport calculations in uniform, sea-level air for one source neutron in each of 30 energy groups and one source photon in each of 12 energy groups. The computer program CDR (Constant Dose Range) uses the new air flux tape to produce ranges of constant dose from a point source in the atmosphere. Author (GRA)

N72-30647# Air Force Weapons Lab., Kirtland AFB, N.Mex.
COMPTON SCATTERING FROM A RELATIVISTIC MAXWELLIAN DISTRIBUTION OF ELECTRONS BY THE DISCRETE S SUB N METHOD Technical Report, Feb. 1970 - Oct. 1971
Brian G. Stephen Feb. 1972 109 p refs
(AD-742228; AFWL-TR-71-179) Avail: NTIS CSCL 20/8

The research effort determined how to numerically represent the scattering kernel for X-ray scattering from a relativistic Maxwellian distribution of electrons in a multigroup discrete (S sub N) treatment of the equation of radiative transfer. Author (GRA)

N72-30648# Utah Univ., Salt Lake City. Dept. of Mathematics.
SCATTERING STATES AND WAVE OPERATORS IN THE ABSTRACT THEORY OF SCATTERING
Calvin H. Wilcox Mar. 1972 30 p refs
(Contract N00014-67-A-0325-0006; NR Proj. 041-370)
(AD-740337; TSR-17) Avail: NTIS CSCL 20/10

The abstract theory of scattering deals with pairs of selfadjoint operators H sub j acting on Hilbert space h sub j,j = 1,2, and the corresponding unitary groups (U sub j)(t) = exp (it(H sub j)), t belongs to R. The purpose of the paper is to present a new abstract definition of the scattering states, based directly on the physical meaning of scattering, and to develop a corresponding theory of wave operators. Author (GRA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N72-30649*# Princeton Univ., N.J. School of Engineering and Applied Science.
PULSED ELECTROMAGNETIC GAS ACCELERATION Semiannual Report, 1 Jul. - 31 Dec. 1971
Robert G. Jahn, Woldemar F. VonJaskowsky, and Kenn E. Clark Jan. 1972 130 p refs
(Grant NGL-31-001-005)
(NASA-CR-127863; SAR-634r) Avail: NTIS HC $8.50 CSCL 20I

Photographs of the exhaust plume of a pulsed MPD discharge through selected narrow band spectral filters reveal a species structure related to the location of the argon mass injection ports. This species structure provides the key to interpretation of time-resolved interferometric velocity measurements in the exhaust. The resulting exhaust velocity increases monotonically from 8500 m/sec at a position 5 cm downstream of the anode face to 16,500 m/sec 40 cm downstream. The latter value is approximately twice the Alfven crictical speed for argon. The growth of the axial electric field near the downstream face of the anode indicates that the discharge operates in a starved mode. Data from biased double probes imply an electron temperature of 0.8 eV in the exhaust plume. Author

N72-30650*# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
THEORETICAL MODELS AND NUMERICAL STUDIES OF WAVES IN A THREE-FLUID MEDIUM
David L. Murphree, ed. Washington NASA Jun. 1972 287 p refs
(Grants NGL-25-001-032; NGL-25-001-028)
(NASA-CR-2071) Avail: NTIS HC $3.00 CSCL 20I

Theoretical models of wave propagation in a three-fluid plasma are developed and numerical solutions to certain aspects of the dispersion and propagation characteristics are obtained. Use of the PL/1-FORMAC mathematical interpretator in the IBM-360-40 computer is discussed. For individual titles, see N72-30651 through N72-30654.

N72-30651* Mississippi State Univ., State College.
NUMERICAL SOLUTION FOR PROPAGATION OF COUPLED LONGITUDINAL AND TRANSVERSE WAVES NORMAL TO THE APPLIED MAGNETIC FIELD IN A THREE-FLUID MEDIUM
Ronald W. McClendon and David L. Murphree *In its* Theoret. Models and Numerical Studies of Waves in a Three-Fluid Medium Jun. 1972 p 1-48 refs (For availability see N72-30650 21-25)
CSCL 20I

A numerical solution to the complete three-fluid plasma dispersion relation, governing the propagation of small perturbations normal to the applied magnetic field, is presented. The waves were coupled longitudinal and transverse waves, and solutions were determined for complex wave numbers for a typical ionospheric condition. Plots of the phase velocity and damping characteristics of the wave modes are given for the frequency range between 0.00001 and 10 to the 9th power radians/second. An analysis of the damping characteristics in the form of the e-folding distance is also presented. The solutions were obtained without making any approximations by using the PL/1 FORMAC interpreter in an IBM 360-40 to carry out the extremely large number of algebraic manipulations involved. N.E.N.

N72-30652* Mississippi State Univ., State College.
NUMERICAL SOLUTION FOR PROPAGATION OF LONGITUDINAL WAVES ALONG THE APPLIED MAGNETIC FIELD IN A THREE-FLUID PARTIALLY IONIZED GAS
Thomas L. Dahl and David L. Murphree *In its* Theoret. Models and Numerical Studies of Waves in a Three-Fluid Medium Jun. 1972 p 49-83 refs (For availability see N72-30650 21-25)
CSCL 20I

A numerical solution for the complete dispersion relation, governing the propagation of small longitudinal perturbations along the magnetic field, is presented. The solutions are determined for typical ionospheric wave numbers, consisting of both real and imaginary parts which describe both the velocity and damping characteristics of each solution. Plots of the phase velocity and damping characteristics of three resulting wave modes are given for the frequency range between 0.00001 and 10 to the 8th power radians/second. The governing equations are linearized, and the complete longitudinal perturbation is described by superimposing the three wave solutions for the three-fluid plasma model. Roots found by Cardan's method as an approximation are substituted into the Newton-Raphson iterative process. N.E.N.

N72-30653* Mississippi State Univ., State College.
EXPANSION AND NUMERICAL SOLUTION OF THE GENERAL DISPERSION RELATION FOR SMALL AMPLITUDE PERTURBATIONS IN A THREE-FLUID PLASMA
Raymond L. Brown and David L. Murphree *In its* Theoret. Models and Numerical Studies of Waves in a Three-Fluid Medium Jun. 1972 p 85-172 refs (For availability see N72-30650 21-25)
CSCL 20I

A complete numerical solution to the general dispersion relation for small amplitude oscillations is presented. The resulting complex numbers are plotted in terms of phase velocity and e-folding distance versus disturbance frequency for the frequency range between 0.00001 and 10 to the 9th power radians/second. The dispersion relation is expanded and solved without approximation. All variables are eliminated except the three components of electron fluid velocity. The real and imaginary parts of the wave number provide the velocity and damping characteristics of each solution. Comparisons with other published results are discussed. N.E.N.

N72-30654* Mississippi State Univ., State College.
ANALYSIS OF THE MIXED INITIAL BOUNDARY VALUE PROBLEM FOR A THREE-FLUID PLASMA WITH A NUMERICAL EXAMPLE
Billy H. Johnson and David L. Murphree *In its* Theoret. Models and Numerical Studies of Waves in a Three-Fluid Medium Jun. 1972 p 173-280 refs (For availability see N72-30650 21-25)
CSCL 20I

Numerical solutions are presented to the governing nonlinear equations and linearized equations of the three-fluid plasma given an initial equilibrium state and some forced disturbance at a particular point as a function of time. A finite difference technique is used to find the numerical solutions. The initial quasi-linear first order partial differential equations are put into a single matrix equation and transformed into a diagonal system. The diagonalization permits the use of the existence theorem and the determination of which variables can be specified. A particular example for which a unique solution was shown to exist was formulated. It was found that the x-components of the electron velocity and the electric field had different values for the linear and nonlinear solutions. However, the solutions became the same within a few spatial steps. N.E.N.

N72-30655*# Illinois Univ., Chicago. Dept. of Energy Engineering.
MAGNETOHYDRODYNAMIC GENERATOR EXPERIMENTAL STUDIES
Edward S. Pierson 12 Jun. 1972 36 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952985)
(NASA-CR-127891) Avail: NTIS HC $4.00 CSCL 20I

The results for an experimental study of a one wavelength MHD induction generator operating on a liquid flow are presented. First the design philosophy and the experimental generator design are summarized, including a description of the flow loop and instrumentation. Next a Fourier series method of treating the fact that the magnetic flux density produced by the stator is not a pure traveling sinusoid is described and some results summarized. This approach appears to be of interest after revisions are made, but the initial results are not accurate. Finally, some of the experimental data is summarized for various methods of excitation. Author

N72-30656# California Univ., Berkeley. Lawrence Berkeley Lab.
LOW FREQUENCY WAVES, STABILIZATION, AND ENHANCED TRANSPORT IN THE PLASMA SURROUNDING A HOLLOW CATHODE DISCHARGE Ph.D. Thesis
George MacGregor Wheeler 6 Jan. 1972 224 p refs
(Contract W-7405-eng-48)
(LBL-577) Avail: NTIS

Low frequency waves, particle transport, and stabilization are studied in the secondary plasma of a hollow cathode arc discharge. Plasma is transported across and along an axial magnetic field of 580 to 1160 gauss by diffusion in a partially ionized plasma, by mobility in the radial electric field, and by wave-enhanced convection. Experimental studies were made for each. NSA

N72-30657# Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering.
INVESTIGATION OF DOPPLER SHIFTED Hbeta RADIATION EMITTED FROM AN ELECTROSTATICALLY CONFINED, SPHERICALLY SYMMETRIC, HYDROGEN PLASMA M.S. Thesis
Robert John McKeon Sep. 1971 57 p refs Sponsored by AEC
(COO-3421-2) Avail: NTIS

Spectroscopic observations through the center of an electrostatically-confined, spherical, hydrogen plasma are reported. These observations indicate the presence of a wing structure about the H sub beta line, i.e., lambda = 4861.3 A. A theory which yields the above wavelength dependence is proposed. The theory assumes spherical symmetry, no space charge effects, and, the presence of fast, excited, hydrogen atoms resulting from charge exchange or dissociation collisions between H2(+) ions and background neutrals. A comparison of the values of weak interaction lambda sub max determined from the experimental data and calculated using the Doppler formula indicates good agreement. The observed wing structure exhibits an unpredicted asymmetry, as yet unexplained, about the undisturbed H sub beta line. Author (NSA)

N72-30658# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
CLASSICAL PLASMA DIFFUSION
Harold Grad Nov. 1971 31 p refs Presented at Conf. on Plasma Theory, Kiev, 19-23 Oct. 1971
(Contract AT(30-1)-1480)
(NYO-1480-184; Conf-711016-10; MF-69) Avail: NTIS

Macroscopic plasma diffusion as governed by the simplest form of Ohm's law for small mean free path is a very complex phenomenon which is by no means described by the classical 1/B2 formula. Diffusion across a magnetic field is, in general, a nonlocal, nonlinear, and transient combination of skin effect, field diffusion, plasma diffusion, and singular convection. It turns out that several orders of magnitude are at stake in balancing these competing effects. There is probably at least as large an unknown factor to be determined in the equivalent calculation still to be done with a kinetic physical model. The basic question of when transport coefficients can be calculated as averages over flux surfaces is examined. Author (NSA)

N72-30659# Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research.
ON THE INSTABILITY OF THETA-PINCH PLASMA WITH AZIMUTHAL MAGNETIC FIELD
T. A. El-Khalafawy, A. M. Youssef, and V. G. Diatlov 1971 16 p refs
(UARAEE-119) Avail: AEC Depository Libraries

Characteristics parameter and magnetic field component measurements by magnetic probes as spatial and temporal functions of theta pinch plasma with azimuthal magnetic field, give evidence of the existence of toroidal magnetic surfaces during about 5 microseconds. The system major radius is approximately 3 cm, the minor one 2 cm. Using the magnetic measurement results, the topography of the azimuthal plasma current was calculated. The results prove large scale MHD instabilities when the Kruskal-Shafranov criterion is not satisfied. The stabilization is possible if the azimuthal magnetic field increases. The electron current velocity was estimated, deduced from the plasma density and plasma current density; it turned out to be of the order of the thermal electron velocity. This makes possible the appearance of hydrodynamic current instability. The magnetic and electrical probe measurements

show considerable plasma noise with a characteristic frequency of the order of tens of MHz. Plasma turbulence due to beam-plasma instabilities is the main reason of short lifetime of plasma. Author (NSA)

N72-30660# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Inst. voor Plasma-Fysica.
TURBULENT HEATING OF A PLASMA BY A HIGH ELECTRIC FIELD Ph.D. Thesis - Utrecht Univ.
H. W. Piekaar Dec. 1971 94 p refs
(NP-19245; Rept-71-67) Avail: AEC Depository Libraries

The turbulent heating of a hydrogen plasma column by the passage of an axial current is studied. The plasma is produced by a gas-fed hollow cathode discharge. The plasma column has a length of 0.65 m and a diameter of 15 mm, and is contained in a simple magnetic mirror with a mirror ratio of 2 and a field strength of 0.4 T in the mirrors. The condition for the onset of the turbulent heating, i.e., an electric field exceeding the runaway field strength is imposed when a capacitor of 1.8 microferad at 15 to 40 kV is discharged across the length of the plasma column. The turbulent states can persist up to 5 microseconds and can be ended at a preset time by means of a crowbar switch. In this way the time evolution of the heating process can be followed. Author (NSA)

N72-30661# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
COMPARISON OF DECA 2 MIRROR MACHINE RESULTS WITH A FOKKER-PLANCK COMPUTER CODE
J. Kesner Sep. 1971 27 p refs Sponsored by EURATOM
(EUR-CEA-FC-611) Avail: AEC Depository Libraries

A program using a Fokker-Planck code is used to numerically investigate the behavior of a plasma confined by magnetic mirrors. The Fokker-Planck equation is resolved for a plasma in a square well. The term corresponding to the plasma source (a high energy neutral beam) is eliminated from the original program, and a term corresponding to plasma losses due to charge exchange resulting from a time-varying residual pressure is included. The axial distribution of the plasma density in a magnetic field with a variable geometric configuration is studied using the angular distribution obtained for the square well as a base. NSA

N72-30662# Institut fuer Plasmaphysik G.m.b.H., Garching (West Germany).
PRODUCTION OF HOT PLASMAS OF SOLID STATE DENSITY BY ULTRASHORT LASER PULSES
H. Salzmann Dec. 1971 49 p refs In GERMAN; ENGLISH Summary
(IPP-IV-23) Avail: AEC Depository Libraries

Ultrashort laser pulses emitted by a neodymium glass laser system were focused on the surface of solid targets situated in a high vacuum environment. The laser pulse duration as measured by the TPF technique was less than ten to the minus 11 power sec. Pulse energies up to 3 J were obtained, corresponding to a maximum energy release of 3 x 10,000 J/sq cm in the focal area. The plasmas produced from targets of solid deuterium, carbon, and thin foils of Mylar were investigated by X-ray measurements, TOF measurements using charge collecting probes and, in the case of deuterium, by neutron counters. Only 10% of the incident light energy was found to be reflected from the targets. Electron temperatures of 500 and 200 eV were measured for deuterium and carbon plasmas, respectively. The experimental results are found to be consistent with the predictions of the model of a thermal wave penetrating into the solid. Author (NSA)

N72-30663# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
STUDY OF HIGH-FREQUENCY HEATING OF A DENSE PLASMA IN THE TOROIDAL MAGNETIC FIELD
S. S. Ovchinnikov, S. S. Kalinichenko, P. T. Kurilko, O. M. Shvets, and V. T. Tolok 1971 37 p refs In RUSSIAN
(KHFTI-71-6) Avail: AEC Depository Libraries

The general features of the toroidal apparatus Omega are described, with its provision for slow heating of the plasma in a closed magnetic trap by a high-frequency field. The input of high-frequency power into a plasma held in a toroidal trap within a metallic chamber was one of the primary goals of the study; the other was the effective heating of plasma during thermalization of the energy of the exciting wave. NSA

N72-30664# Akademiya Nauk URSR, Kharkov. Fiziko-Teknicheskii Inst.
STUDY OF THE EFFECT OF A PLASMIC DIAPHRAGM ON THE ELECTRICAL DRIFT OF A PLASMIC STREAM INJECTED INTO THE TOROIDAL MAGNETIC FIELD WITH A DIVERTER
V. G. Zykov, V. I. Karpukhin, N. I. Rudnev, and V. T. Tolok 1971 17 p refs In RUSSIAN
(KHFTI-70-80) Avail: AEC Depository Libraries

The basis of the apparatus used in this study was the stellarator Sirius, equipped with a plasma injector. A semitorus whose large radius was 41 cm was attached to the diverter of the stellarator. The internal diameter of the vacuum chamber was 7 cm, and induction coils provided a magnetic field of 10 kOe. A comparative study of plasma drift was made in the toroidal magnetic field from the diverter or the solenoidal configuration at the entrance. The polarizing interaction of the coaxial plasma streams in the magnetic field of a toroidal solenoid was investigated. NSA

N72-30665# European Space Research Inst., Frascati (Italy).
HYDROMAGNETIC PROPERTIES OF A MAGNETIC NEUTRAL SHEET MODEL AND RECONNECTION RATES
J. F. McKenzie and M. Bornatici [1972] 21 p refs Submitted for publication
Avail: NTIS HC $3.25

Using a plane magnetic neutral sheet configuration which allows plasma to escape the system, it is shown that Alfven's relation for the Mach number of the incoming flow is replaced by conditions on the Mach number appropriate to unchoked flow. When the flow is unchoked there are two possible solutions for the ejection state; one solution corresponding to the plasma being ejected at high speeds and the other for the state of the ejected plasma corresponding to a nearly incompressible state which exits the system at much slower speeds. In this case the corresponding electric field varies more gently across the sheet. It is concluded that the conditions on the Mach number for unchoked flow in the plane of the sheet need not hamper magnetic field line reconnection.
Author (ESRO)

N72-30666# European Space Research Inst., Frascati (Italy).
NONLINEAR STABILIZATION OF E X B ELECTRON DRIFT INSTABILITY WITH T SUB i EQUIVALENT TO T SUB e
Andre Rogister 1972 8 p refs Submitted for publication
Avail: NTIS HC $3.00

It is shown that nonlinear electron cyclotron resonant effects—the analog of nonlinear electron Landau damping for propagation orthogonal to a strong magnetic field—stabilize the E x B electron drift instability for T sub e equivalent to T sub i at short wavelengths, but has a destabilizing effect at long wavelengths. The total wave energy however is stabilized by this mechanism. the equation of overall energy balance predicts that the theoretical turbulence level at k = 1/lambda sub d is a few hundred times suprathermal as found experimentally.
Author (ESRO)

N72-30667# European Space Research Inst., Frascati (Italy).
ON THE EXISTENCE OF CRITICAL LEVELS, WITH APPLICATIONS TO HYDROMAGNETIC WAVES
James F. McKenzie [1972] 33 p refs Submitted for publication

Avail: NTIS HC $3.75

It is proved that a critical level, at which a wave packet is neither reflected nor transmitted, can exist only if the wave normal curve, which is formed by taking the cross section through the wave normal surface in the plane of propagation, possesses an asymptote which is parallel to the direction of variation of the properties of the medium through which the wave packet moves. This condition, when applied to various types of hydromagnetic waves shows that critical levels for such waves may exist only if the direction of spatial variations of the medium is perpendicular to the ambient magnetic field.

Author (ESRO)

N72-30668# Institut Franco-Allemand de Recherches, St. Louis (France).

DIAGNOSTICS OF TURBULENCES. PART 1: VISUALIZATION [DIAGNOSTIC DES TURBULENCES. 1ERE PARTIE: VISUALISATIONS]

P. Smigielski, F. Albe, H. Fagot, and R. L. Oudin 15 Nov. 1971 17 p refs In FRENCH Presented at the 8th Assoc. Franc. des Ingr. et Techniciens de l'Aeron. et de l'Espace Colloq. on Aerodynamique Appl., St. Louis, France, 8-10 Nov., 1971

(ISL-38/71) Avail: NTIS HC $3.00

Some methods are described for visualizing turbulent flow around hypervelocity projectiles, whether showing optical path variations by methods such as schlieren photography in incoherent light and differential interferometry in polarized light, or methods using light scattering by microparticles injected into the gas, such as holography. ESRO

N72-30669# Academy of Sciences (USSR), Moscow. Inst. for Space Research.

SOLAR PLASMA INTERACTION WITH MARS: PRELIMINARY RESULTS

O. L. Vaisberg, A. V. Bogdanov, N. F. Borodin, A. A. Zertzalov, B. V. Polenov, and S. A. Romanov 1972 12 p refs Presented at the 15th COSPAR Meeting, Madrid, 1972

(D-143) Avail: NTIS HC $3.00

The region with high intensity of $E < 150$ eV ions was observed near Mars. The outer boundary shape of this region and sharp jump of the ion velocity and temperature suggest the existence of a collisionless shock wave. Beyond the shock wave the ion flux appears to be disturbed by the outer atmosphere of Mars. Author (ESRO)

N72-30670# Academy of Sciences (USSR), Moscow. Inst. for Space Research.

NONLINEAR WAVES IN GEOMAGNETIC WAKE

A. I. Ershkovich, A. A. Nussinov, and A. A. Chernikov 1972 11 p refs

(PR-104) Avail: NTIS HC $3.00

Nonlinear effects in the geomagnetic tail are studied assuming the tail to be a plasma cylinder with a free boundary subject to solar wind flux. Fluctuations connected with Kelvin-Helmholtz instability arising in the tail cause it to lose its structure and develop into a turbulent wake. ESRO

N72-30671# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Elektrische Antriebe.

ON THE DIAGNOSTICS OF NITROGEN PLASMA JETS IN THERMODYNAMIC NONEQUILIBRIUM Ph.D. Thesis - Brunswick Univ. [ZUR DIAGNOSTIK VON STICKSTOFF-PLASMASTRAHLEN IM THERMODYNAMISCHEN NICHTGELICHGEWICHT]

Une W. Sprengel Apr. 1972 111 p refs In GERMAN; ENGLISH summary

(DLR-FB-72-36) Avail: NTIS HC $7.75; DFVLR, Porz 24 DM

The effect of an elevated electron temperature above the heavy particle temperature on the diagnostics of nitrogen plasma jets is investigated. It is shown that the static state properties can be determined from the given values of the specific enthalpy, pressure and electron temperature at the stagnation point. Both extreme cases are considered during stagnation: equilibrium of dissociation and ionization as well as a constant degree of thermodynamic nonequilibrium; and constant relative plasma composition and specific partial entropies.

Author (ESRO)

N72-30672# Miami Univ., Coral Gables, Fla. Dept. of Physics.

EXPERIMENTAL STUDY OF FORCE FREE, COLLINEAR PLASMA STRUCTURES Interim Report

Eugene E. Nolting, Paul E. Jindra, and Daniel R. Wells May 1972 33 p refs

(Grant AF-AFOSR-2295-72; AF Proj. 9752)

(AD-741913; MIAPH-PP-72-2; AFOSR-72-1040TR) Avail: NTIS CSCL 20/9

Detailed measurements of the trapped magnetic fields and currents in plasma structures generated by conical theta-pinches are reported. Studies of these structures interacting with a magnetic barrier, and with each other in a collision at the center of a magnetic mirror, are reported. The magnetic well formed by the collision has been studied by simultaneous use of several diagnostic techniques. The measurements are in agreement with a force-free, collinear magnetic field configuration (Wells, 1972). Arguments relating superposability and collinearity of flow fields to these observations are given. Author (GRA)

N72-30673# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS IN THE PHYSICS OF LOW TEMPERATURE PLASMA (SELECTED ARTICLES)

28 Jan. 1972 248 p refs Transl. into ENGLISH from the publ. "Voprosy Fiziki Nizkotemperaturnoi plazmy" Minsk, Nauka i Tekhn., 1970 p 3-36, 256-258, 424-428, 449-459, 480-483, 496-528, 532-549, 554-566, 570-576, 585-589, and 600-603

(AD-742377; FTD-MT-24-1025-71) Avail: NTIS CSCL 20/9

The document contains the materials of reports and papers presented at the Second All-Union Conference on Physics of Low-Temperature Plasma. It considers such questions as the methods for obtaining and studying low-temperature plasma, used in different set-ups of new technology. A considerable part of the book is dedicated to electrical and optical properties of plasma, oscillatory phenomena, phenomena in a magnetic field and a moving plasma. Together with such applied problems as the interaction of a stationary and moving plasma with surfaces, the deep physical problems of the elementary processes taking place in a low-temperature plasma are also studied.

Author (GRA)

N72-30674# Miami Univ., Coral Gables, Fla. Dept. of Physics.

THE CURRENT ALGEBRA OF GLOBAL MHD STABILITY Interim Report

Daniel R. Wells 1972 54 p refs

(Contract F19628-69-C-0072-P001; Grant AF-AFOSR-2295-72; AF Proj. 9752)

(AD-741912; MIAPH-PP-70-13; AFOSR-72-1039TR) Avail: NTIS CSCL 20/9

A theory of nonlinear global magnetohydrodynamic stability is described. The formalism is an entirely new approach to the problem. The concepts of space-time and generalized gauge symmetries of the flow fields are invoked to find constants of the motion. The constants correspond to charge operators in a theory of the current algebra of the fields. The charges, in turn, are defined by integrals that are determined by the symmetries of the fields. The strengths of the individual components of the currents determine the amount of symmetry breaking in each physical situation. The constants of the motion corresponding to the charge operator are used in conjunction with the principle of least constraint to generate the Euler-Lagrange equations corresponding to stable plasma motion. Author (GRA)

N72-30675# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

INVESTIGATION OF THE NONLINEAR MECHANICS OF

UNSTABLE PLASMAS Final Report, 1967 - 1971
Herbert Lashinsky Feb. 1972 17 p refs
(Grant AF-AFOSR-1016-67; AF Proj. 9783)
(AD-740659; AFOSR-72-0767TR) Avail: NTIS CSCL 20/9

The research supported by this grant has been devoted to exploring the possibility of applying theoretical and experimental techniques that are well-known in lumped-parameter systems such as vacuum-tube oscillators, microwave devices, etc. to the study of distributed-parameter systems such as plasmas. One long-term objective of the work is the investigation of dynamic-stabilization methods for various instabilities in typical distributed-parameter systems; particular interest attaches to plasma instabilities and turbulence phenomena that affect high-speed plasma flow and plasma confinement. This objective, however, means that the relevant theoretical and experimental aspects of nonlinear behavior in plasmas must be understood and this has been the primary objective of the program. The report contains a broad statement of the problem area and a description of the theoretical and experimental approaches taken, a summary of the major results obtained, and a list of published articles, and reports where the complete details of the work are available. Author (GRA)

N72-30676# Michigan Univ., Ann Arbor. Dept. of Physics.
IONIZATIONAL RELAXATION IN SHOCK-HEATED MERCURY VAPORS Final Report
James Harvey Dell Jan. 1972 111 p refs
(Grant AF-AFOSR-1849-70; AF Proj. 9750)
(AD-740664; Rept-032150-F-1; AFOSR-72-0816TR) Avail: NTIS CSCL 20/9

A uniformly heated, pressure-driven shock tube was used to produce 4200 K to 12,000 K mercury plasmas in which the relaxation process was studied. The total plasma luminosity was observed using a photomultiplier tube, with the time of shock passage and shock velocity established using a schlieren optical system. It is shown that the ionizational relaxation time depends inversely on the initial vapor pressure or atom number density, and directly on the final electron number density. A previously unobserved feature of ionizational relaxation has been detected. The luminosity profile shows two distinct points at which the slope of the curve changes abruptly. Impurities are seen to affect the shape of the relaxation profile greatly. Author (GRA)

N72-30677# New York Univ., N.Y. Dept. of Electrical Engineering.
MICROWAVE SCATTERING FROM UNDERDENSE AND OVERDENSE TURBULENT PLASMAS
David Attwood Jan. 1972 174 p refs
(Contract N00014-67-A-0467-0018)
(AD-741187; TR-402-10) Avail: NTIS CSCL 20/9

Experimental results of microwave scattering from turbulent plasma are presented and compared with pertinent theories. For underdense values of mean and fluctuation electron density, scattering is similar to that noted by several other groups, following Born predictions for very weak scattering and saturating as the critical point is approached. Near the critical point for average electron density, a cross-over from volume to surface scattering is observed. For sufficiently overdense values scattering resembles that from a reflecting surface of appropriate shape and statistics, mean density distribution notwithstanding. Scattering in this latter regime is used as a diagnostic tool to determine the probability distribution function for orientation fluctuations displayed by the overdense thrashing plasma column. Author (GRA)

N72-30678# Avco Corp., Wilmington, Mass.
RADIATION STUDIES OF ARC HEATED PLASMAS Final Report, Jan. 1970 - Jul. 1971
J. C. Morris and J. M. Yos Wright-Patterson AFB, Ohio ARL Dec. 1971 528 p refs
(Contract F33615-70-C-1360; AF Proj. 7063)
(AD-740570; AVSD-0390-71-CR; ARL-71-0317) Avail: NTIS CSCL 20/9

The report presents tables of the continuum radiation from argon, nitrogen, oxygen, and air in the spectral range from 950 A to 6.0 micrometers, for temperatures from 9000 to 30,000 degrees K and pressures from 1 to 30 atm. For the neutral atoms and singly charged ions, these tables are based on the authors' previously reported experimental data, while for doubly charged ions, they are based on new quantum defect calculations of the radiation. Also included in the report are tables of the Stark widths and shifts for singly ionized argon lines at temperatures from 15,000 to 25,000 degrees K, as calculated from Griem's semi-empirical treatment. These results are compared with experimental data on the Stark shifts of several AII lines at 20,000 degrees K, which were measured in the pulsed argon arc. Author (GRA)

N72-30679# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INITIAL STAGES OF THE LASER PLASMA MOTION IN THE REGIME OF GAS-DYNAMIC EXPANSION
N. G. Basov, V. A. Boiko, V. A. Gribkov, S. M. Zakharov, O. N. Krokhin, and G. V. Sklizkov 21 Jan. 1972 21 p refs Transl. into ENGLISH from Tr. Akad. Nauk SSSR, Fiz. Inst. (Moscow), no. 38, 1971 p 1-21
(AF Proj. 8809; AF Proj. 3326)
(AD-741495; FTD-MT-24-1145-71) Avail: NTIS CSCL 20/9

The paper deals with experimental investigation of gas-dynamic properties of the laser plasma, created by focusing power laser radiation on the carbon target surface. The time dependence of the plasma pressure in the heated part, mass flux from the target surface and heated plasma mass are measured by the method of time scanning of the interferogram split image with an image converter tube. The gas-dynamic processes taking place in the heated plasma are discussed. It is observed that in the case of a multimode Q-switched laser the plasma pressure maximum is reached at the pulse beginning. Maximum plasma pressure reaches up to 10(superscript 6) barr at a laser energy of 8 joules. Author (GRA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-30680# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
SOLID STATE CHEMISTRY Symposium Proceedings
Robert S. Roth, ed. and Samuel J. Schneider, Jr., ed. Jul. 1972 761 p refs Proc. of the 5th Mater. Res. Symp. on Novel High Temp. Mater., Gaithersburg, Md., 18-21 Oct. 1971; sponsored by NBS
(NBS-SP-364; LC-72-600031) Avail: SOD $7.50 as C 13.10:364

Data from a conference on Solid State Chemistry are summarized. The summaries include inorganic crystalline materials emphasizing crystal-chemical and structural aspects; research problems, and research techniques. Data also cover oxides, bromides, carbides, silicides and related materials, chalcogenides, and nonstoichiometry. For individual titles, see N72-30681 through N72-30739.

N72-30681 Lund Inst. of Tech. (Sweden). Div. of Inorganic Chemistry.
THE STEREOCHEMISTRY OF THE INERT PAIR IN SOME SOLID OXIDES FOR OXIDE FLUORIDES OF Sb(3 PLUS), Bi(3 PLUS) AND Pb(2 PLUS)
Sten Andersson and Anders Astroem *In* NBS Solid State Chem. Jul. 1971 p 3-14 refs Sponsored by Swed. Nat. Sci. Res. Council (For availability see N72-30680 21-26)

Geometrically it is shown that the inert electron pair in

some solid oxides or oxide fluorides requires space comparable with that of an anion. If the lone pairs are located on certain sites in a lattice, nets consisting of lone pairs and anions are obtained which correspond to hexagonal, or cubic closest packing of atoms. Other more complex nets, comparable with those in alloy structures, are also found. The lone pairs are thus found in positions which are normally occupied by anions. Using this observation, direct structural relationships with the transition metal compounds can be shown to exist. Author

N72-30682 Monash Univ., Clayton (Australia). Dept. of Chemistry.
THE SINGLE CRYSTAL X-RAY STRUCTURE DETERMINATION OF SOME ALKALI METAL MOLYBDATES AND NIOBATES
B. M. Gatehouse, D. J. Lloyd, and B. K. Miskin *In* NBS Solid State Chem. Jul. 1972 p 15-27 refs Supported in part by Australian Res. Grants Comm. (For availability see N72-30680 21-26)

Crystal structures were determined for the compounds Rb3Nb54O146, RbNb3O9, Na(x)Mo6O17, K(x)Mo6O17 (x approximately 0.8 and 1.0 respectively) and Li2Mo4O13 (low temperature form). Preliminary results are communicated for the compounds Li(x)Mo6O17 (x less than or equal to 1.0) and Li2Mo4O13 (high temperature form). For Rb2Nb54O146 an unusual structure occurs where niobium-oxygen octahedra are grouped forming four, five, six and seven-sided tunnels through the structure, with the hexagonal tunnels partly filled with rubidium atoms. The unbalanced electrostatic charge is discussed in terms of the possible presence of fluoride, or fractional occupancy of oxygen sites. Unusual features are discussed for the M(x)(I)Mo6O17 structures in terms of the presence or absence of Mo-O6 octahedra or Mo-O4 tetrahedra in the structure. It appears that the lithium analogue will have a somewhat different structure in spite of similarity in unit cell dimensions. The ordering of lithium-oxygen octahedra in planes in Li2Mo4O13 is pointed out in an accurate structure determination of this compound, which is basically a cubic close-packed oxygen lattice with Li and Mo occupying octahedral sites. Systematically absent oxygen atoms result in the presence of pairs of strings of cube octahedral holes in the structure. Author

N72-30683 Bordeaux Univ. (France). National Center of Scientific Research Lab. of Inorganic and Structural Chemistry.
THE CRYSTAL CHEMISTRY OF SOME NEW MIXED OXIDES OF TELLURIUM(PLUS 4)
Jean Galy *In* NBS Solid State Chem. Jul. 1972 p 29-39 refs (For availability see N72-30680 21-26)

A new structural type MTe3O8 was found in the TeO2 - MO2 systems (M = Ti, Zr, Hf and Sn). The structure of TiTe3O8 determined by X-ray single crystal analysis is cubic, space group Ia3 with a = 10.956 A. The relationships with the fluorite structure type were established ZrTe3O8 as well as fourteen new compounds with the general formula. In the system T3O2 - VO2 the phase TeVO4 was prepared in two different crystalline forms, designated as alpha and beta. A reversible polymorphic transformation occurs at 650 C. Both phases crystallize in the monoclinic system. Finally, relationship between the structure of alpha and beta TeVO4 and other long pair structures such as alpha-Sb2O4, beta-SbNbO4, beta-Sb2O4 and Pb3O4 is discussed, and comparison with such simple structures as alpha-PbO2, ReO3, PdF3 and TiO2 rutile was also made. Author

N72-30684 Iowa State Univ. of Science and Technology, Ames.
CRYSTAL STRUCTURE AND PHYSICAL PROPERTIES OF A TRICLINIC SODIUM TUNGSTEN OXIDE
H. F. Franzen, H. R. Shanks, and B. H. W. S. DeJong *In* NBS Solid State Chem. Jul. 1972 p 41-50 refs Prepared by Iowa State Univ. of Sci. and Technol. in cooperation with Ames Lab. of the AEC (For availability see N72-30680 21-26) (Contrib-3126)

The triclinic sodium tungstate was prepared by the method of electrolysis of molten mixtures Na2WO4 and WO3 which was used extensively in the preparation of sodium tungsten bronzes. The electrical resitivities and Seebeck coefficients of several samples were measured and are reported. A single crystal X-ray diffraction study yielded the tungsten atom positions. A structure is suggested which is consistent with the tungsten positions and the electrical properties. The suggested stiochiometry is Na6W14O45. In the suggested structure the tungsten atoms are coordinated by distorted octahedra of oxygen atoms in all cases but one, in which case the tungsten is coordinated by a trigonal-bipyramid of oxygen atoms. The octahedra share corners in planes in a fashion similar to that found in the hexagonal bronze, and the sodium atoms are located in the resulting hexagonal holes. Author

N72-30685 Stanford Univ., Calif. Dept. of Materials Science and Engineering.
ELECTROCHEMICAL PREPARATION AND CHARACTERIZATION OF ALKALI METAL TUNGSTEN BRONZES, M(x)WO3
M. S. Whittingham and R. A. Huggins *In* NBS Solid State Chem. Jul. 1972 p 51-62 refs Supported by ARPA and NSF (For availability see N72-30680 21-26)

The thermodynamic aspects of the processes occuring during the electrolytic decomposition of alkali metal tungsten bronzes are discussed. The decomposition of tungsten melts to form sodium and potassium tungsten bronzes is emphasized. Also discussed are composition of the products formed, composition dependence of the decomposition potentials, and the conditions necessary for the growth of homogeneous products of desired composition and phase. Author

N72-30686 Justus Liebig-Universitaet, Giessen (West Germany).
SOME ASPECTS OF THE INVESTIGATION OF INTERGROWTH PHASES IN Nb2O5-RICH SYSTEMS
Reginald Gruehn *In* NBS Solid State Chem. Jul. 1972 p 63-86 refs Supported by Landesamt fuer Forsch. Duesseldorf and by Fonds der Chem. Ind., West Ger. (For availability see N72-30680 21-26)

Several methods, suitable for the investigation of oxide systems and for preparation of monophase samples in Nb2O5 rich systems, are examined. Four hybrid intergrowth phases were found using X-ray methods. The preparative methods used and the test results obtained are given in tabular form. E.H.W.

N72-30687 Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Tribophysics.
THE APPLICATION OF ELECTRON OPTICAL TECHNIQUES TO HIGH TEMPERATURE MATERIALS
John G. Allpress *In* NBS Solid State Chem. Jul. 1972 p 87-111 refs (For availability see N72-30680 21-26)

The question of how and why electron microscopic techniques can be used in phase equilibria studies of high temperature systems is discussed. The techniques were used in the following studies: (1) electron diffraction determination of unit cell data for microcrystalline samples of alkali metal rare earth titanates; (2) dark field microscopy study of the precipitation of ferrimagnetic spinel LiFe5O8 from a nonstoichiometry matrix of alpha-LiFeO2; (3) direct observation of crystallographic shear planes in WO(3-x); (4) lattice imaging study of the regions of solid solution in the system TiO2-Nb2O5; and (5) study of phases in the system WO3-Nb2O5 which have structures related to that of tetragonal tungsten bronze. Author

N72-30688 Pennsylvania State Univ., University Park. Materials Research Lab.
APPLICATION OF INFRARED AND RAMAN SPECTROSCOPY TO THE CHARACTERIZATION OF ORDER-DISORDER IN HIGH TEMPERATURE OXIDES
William B. White and Vassilis G. Keramidas *In* NBS Solid State

Chem. Jul. 1972 p 113-126 refs (For availability see N72-30680 21-26)
(Contract F33615-69-C-1105)

The use of vibrational spectroscopy as a tool for the detection of ordering in high temperature oxides is examined. Raman spectra of various classes of compounds with ordering schemes derived from the rocksalt, rutile, corundum, perovaskite, and spinel structure were determined. Efforts were made to test the extent to which the ordering arrangements affect the Raman spectra. Author

N72-30689 General Electric Co., Schenectady, N.Y. Corporate Research and Development.
OBSERVATIONS IN THE ELECTRON MICROSCOPE OF LATTICE PLANES AND MIGRATION OF SILVER IN BETA ALUMINA
W. L. Roth *In* NBS Solid State Chem. Jul. 1972 p 129-137 refs (For availability see N72-30680 21-26)

Electron microscope observations were made of sodium and silver beta alumina relevant to the movement of ions through the crystals. The lattice planes responsible for conduction in sodium beta alumina were resolved and the migration and reduction of silver ions to silver by electrons were observed. Results also show sodium ions were reduced to atomic sodium by electrons incident on beta alumina. E.H.W.

N72-30690 Stanford Univ., Calif. Dept. of Materials Science and Engineering.
BETA ALUMINA - PRELUDE TO A REVOLUTION IN SOLID STATE ELECTROCHEMISTRY
M. S. Whittingham and R. A. Huggins *In* NBS Solid State Chem. Jul. 1972 p 139-154 refs Supported by ONR, ARPA, and Environ. Protection Agency (For availability see N72-30680 21-26)

The use of solid state electrochemical techniques to study the thermodynamic and transport properties of materials is discussed. Transport measurements were made of single crystals of beta alumina to test its suitability as a solid electrolyte. By use of a group of non-polarizing solid electrodes it was possible to study the ionic conductivity of a series of beta aluminas containing alkali metals as well as thallium over a wide temperature range. The electronic conductivity of silver beta alumina was also determined by use of the Wagner asymmetric polarization technique over wide ranges of temperature and oxygen partial pressure. The results of these studies indicate that the beta alumina family shows excellent promise for use as solid electrolytes, exhibiting high values of ionic conductivity and a very low electronic transference number. Author

N72-30691 Tohoku Univ., Sendai (Japan). Dept. of Physics.
EXPERIMENTAL STUDY ON THE IONICITY IN THE TiO PHASE. AN APPLICATION OF THE NEW METHOD OF DETERMINING THE STRUCTURE FACTOR BY HIGH VOLTAGE ELECTRON DIFFRACTION
D. Watanabe and O. Terasaki *In* NBS Solid State Chem. Jul. 1972 p 155-164 refs Supported in part by Tokyo Univ. Inst. for Solid State Phys., Min. of Educ., and the Sakkokai Found. (For availability see N72-30680 21-26)

The use of accelerating voltage electron diffraction to determine the disordered phases of TiO is discussed. The accelerating voltages were measured using a 500 kV electron microscope. The measured values are 340, 354, 389, and 425 kV respectively for TiO(0.96), TiO(1.16), and TiO(1.25). To compare the experimental values with calculation, the values of the accelerating voltage were calculated for TiO(0.82) and TiO(1.25) using theoretical scattering factors Ti and O atoms of various atomic states. The calculations were made for free neutral atoms Ti, O, monovalent ions Ti(1+) O(1-) and divalent ions Ti(2+), O(2-). The structure factors of the first order were determined using the measured values of accelerating voltage. Comparison of the experimental values of accelerating voltage and the first order structure factors with theoretical ones enables us to discuss the ionicity in a TiO crystal. The result shows that the ionicity depends on the oxygen concentration in the crystals. Titanium and oxygen atoms in the oxygen-deficient TiO crystal are considered to be almost neutral, while the elements in the titanium-deficient crystal appear to be in the ionic states. The possibility of applying the present method to a TiO2 crystal of the rutile type is discussed. Author

N72-30692 New South Wales Univ., Kensington (Australia). School of Chemistry.
THE STRUCTURE AND INTERGROWTH OF THE POLYMORPHIC FORMS OF ZrO2-16Nb2O5
N. C. Stephenson, J. P. Beale, and D. C. Craig *In* NBS Solid State Chem. Jul. 1972 p 165-182 refs (For availability see N72-30680 21-26)

The compound ZrO2.12Nb2O5 was reported to exist in three polymorphic forms, one of which is isostructural with TiNb24O62. The crystal structures of the remaining two polymorphs were determined by examining X-ray data collected from a single crystal of the beta-monoclinic form. The unit-cell dimensions are a = 39.693, b = 3.380, c = 35.488 A, beta = 116.53 deg. Using a single crystal diffractometer and CuK alpha radiation, 2948 data were collected. No assumptions were made about the structural features and the basic subcell unit was deduced from the Patterson function. Modifications of this subcell give rise to the remaining two polymorphs, which contain blocks of 3x3, 4x4, and 3x4 corner sharing octahedra. The 3x4 blocks are all at the one level and form sheets running parallel to (100). The 3x3 and 4x4 blocks form sheets which alternate with those just described. The manner in which the sheets fit together determines which polymorph is formed. Although the structures were solved using standard X-ray procedures, the solutions were facilitated by using features of electron transmission micrographs. These consisted of a regular array of dots and streaks (plane group p2) arranged in lines parallel to c. The spacial distribution and contrast of these dots and streaks, together with their arrangements at antiphase boundaries and fault areas, impose certain restrictions upon structures that can be derived by modifications of the basic subcell. Author

N72-30693 National Bureau of Standards, Washington, D.C.
SUPERSTRUCTURE OF THE ORTHORHOMBIC Nb2O5-6ZrO2 TYPE PHASE(S) IN THE Nb2O5-ZrO2 AND Ta2O5-ZrO2 SYSTEMS
Robert S. Roth, J. L. Waring, W. S. Brower, and H. S. Parker *In its* Solid State Chem. Jul. 1972 p 183-195 refs (For availability see N72-30680 21-26)

The systems Nb05-ZrO2 and Ta2O5-ZrO2 were examined to determine the nature of the nonstoichiometric orthorhombic phase or phases present in these systems. The X-ray diffraction powder patterns indicate a series of phases with subcells similar to alpha-PbO2 and orthorhombic symmetry. Superstructure lines indicate that these phases have a multiple b axis. The composition 2:9 corresponds approximately to a structure with a b-axis multiplicity of seven. The 2:11 composition appears to have a multiplicity of eight, 2:13 a multiplicity of nine and the last composition 2:15, a multiplicity of ten. The intermediate compositions 1:5, 1:6 and 1:7 show superstructure lines halfway between those of the simpler phases on either side, corresponding to multiplicities of 15, 17 and 19 respectively. These multiplicities and compositions thus appear to belong to a homologous series M(n-1)O2(n) where n varies from 14 to 20. However the phase equilibria data do not rule out the possibility of a homologous series m(n)O2(nh). Compositions in the Ta2O5-ZrO2 system apparently have the same composition however, their melting points are considerably higher. Single crystals of these phases, prepared by both direct cooling of a melt and utilization of a barium vanadium oxide eutectic flux, have enabled the multiplicities to be completely verified and are now being used for crystal structure determinations. Author

N72-30694 Western Australia Univ., Nedlands. School of Chemistry.
PHYSICAL AND GEOMETRIC PRINCIPLES OF CRYSTAL-

LOGRAPHIC SHEAR IN RUTILE
L. A. Bursill, B. G. Hyde, and M. OKeeffe (Ariz. State Univ.) *In* NBS Solid State Chem. Jul. 1972 p 197-204 refs Supported in part by AFOSR, NSF, Ariz. State Univ., and the Australian Res. Grants Comm. (For availability see N72-30680 21-26)

The physical and geometrical principles underlying the formation of planar defects in crystallographic shear are considered. It is shown that the only crystallographic shear planes expected in systems derived from rutile are those containing (111) as observed in TiO2-x and TiO2--Cr2O3. These results enable us to establish likely criteria for the development of homologous series in oxide systems. The kinetic consequences of the existence of disordered shear planes (Wadsley defects) are further examined in the light of these developments. Author

N72-30695 Bordeaux Univ. (France). Service de Chimie Minerale Structurale.
STRUCTURES AND CHEMICAL BOND PROBLEMS IN VANADIUM OXIDES
Paul Hagenmuller *In* NBS Solid State Chem. Jul. 1972 p 205-218 refs (For availability see N72-30680 21-26)

In the transition metal oxides the d-electrons may be either in a localized or a collective state depending essentially on the structure, the transition element, and its oxidation state. Some significant examples are given resulting from recent investigations in the field of the vanadium oxycompounds. The results are compared with those obtained for the homologous LnTO3 phase, Ln being a lanthanide and T a 3d-transition element, on the basis of Goodenough's covalent mixing parameters lambda sub pi and lambda sub sigma. The influence of various factors on the physical properties is discussed. Author

N72-30696 Lincoln Lab., Mass. Inst. of Tech., Lexington.
PREPARATION AND STRUCTURE OF A PYROCHLORE AND PEROVSKITE IN THE BiRhO(3 PLUS x) SYSTEM
J. M. Longo, P. M. Reccah, J. A. Kafalas, and J. W. Pierce *In* NBS Solid State Chem. Jul. 1972 p 219-226 refs Sponsored by AF (For availability see N72-30680 21-26)

It was found that the reaction of Bi2O3 with either Rh metal or Rh2O3 (Bi/Rh = 1:1) at 600-1000 C in air or oxygen forms a compound with a face-centered cubic unit cell (a = 10.238 + or - .008 A) and the pyrochlore structure. X-ray fluorescence for the Bi/Rh ratio and thermogravimetric analysis for the oxygen content gave Bi(2.0)Rh(2.0)O(6.8). In the pyrochlore structure the cations are in fixed positions, and there are two types of oxygen. Six oxygen atoms are of one type (O1) with one position parameter and form the octahedra around the B cations. The last oxygen (O2) is fixed and coordinated only to the A cations. It is not essential to the B2O6-Octahedra network. Taking the origin at the B cation, the position parameter for O1, the occupancy factor (OF) for O2 and atomic temperature factors (B) are refined by R-factor minimization of integrated powder diffraction intensity data. The position parameter for O1 is in agreement with those found in other pyrochlores, and the occupancy factor (OF) is consistent with the chemical analysis. The stability of the defect structure in terms of the availability of the inert pair of electrons of the A cation was discussed. Author

N72-30697 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.
PRECIOUS METAL PYROCHLORES
A. W. Sleight and R. J. Bouchard *In* NBS Solid State Chem. Jul. 1972 p 227-232 refs (For availability see N72-30680 21-26)

An extensive program on precious metal pyrochlores including the preparation of new phases, crystal growth, crystallographic studies, and numerous physical measurements is summarized. Metallic conduction is found for Tl2Ir2O7, Tl2Os2O7, Bi2Ru2O7, and Bi2Ir2O7. Magnetic susceptibility measurements confirm the localized electron behavior for the semiconductors and delocalized electron behavior for the metallic compounds. Structural refinements were carried out for Nd2Ru2O7, Yb2Ru2O7, and Bi2Ru2O7. The Ru-O distance is 2.00 + or - .01 A for all three compounds; however, an anomalously high temperature coefficient was found for Bi. Author

N72-30698 National Bureau of Standards, Washington, D.C.
PHASES IN THE SYSTEMS BaO-NiO-O-CO2 AND BaO-CoO-O-CO2
T. Negas and R. S. Roth *In its* Solid State Chem. Jul. 1972 p 233-263 refs (For availability see N72-30680 21-26)

Several new materials related to the aragonite form of BaCo3 and to the 2H form of BaNiO3 were prepared at elevated temperature in air. The phases Ba3NiC(x)O(9-y) and Ba3Ni2C(x)O (9-y) were prepared in powder and single crystal form. Both phases are hexagonal with a-axes related to the 2H BaNiO3. The structure was refined in space group P6 to R = 5.9% using 639 X-ray reflections. BaCO3-3:2 (Ba:Ni) phase composite crystals were prepared by decomposition of 3:1 phase crystals in air at 800 C. The structure for these composites is discussed. Experimental results show the phase relations in the system BaO-cobalt oxide and BaO-nickel oxide are directly influenced by the presence of CO2. In air and at elevated temperatures carbonated phases related to a 2H-type structure are stable and easily prepared. The presence of CO2 causes decomposition of Ba2CoO4 and prevents the formation of 2H-BaNiO3. Author

N72-30699 Polytechnic Inst. of Brooklyn, N.Y. Dept. of Chemistry.
PREPARATION OF SrFe(x)Mn(1 MINUS x)O(3 MINUS y) CRYSTALS AND SOME OF THEIR PROPERTIES
E. Banks, O. Berkooz, and T. Nakagawa *In* NBS Solid State Chem. Jul. 1972 p 265-273 refs (For availability see N72-30680 21-26)
(Contract F44620-69-C-0047; Grant DA-ARO(D)-31-124-G-1036)

A description is given of the preparation of single crystals in the systems SrFe(x)Mn(1-x)O(3-y) and CaFe(x)Mn(1-x)O(3-y) and some observations on their magnetic and electrical properties. Chemical analysis showed that the values of Fe:Mn ratio in these crystals were very close to the expected ones. From the density and X-ray measurements the existence of substantial amounts of oxygen vacancies in the perovskite crystals was observed. For the hexagonal crystals, lower concentrations of oxygen vacancies were observed. The Mossbauer spectra of crystals having x = 0.4 - 0.7 in the SrFe(x)Mn(1-x)O(3-y) system were found to consist of two kinds of quadrupole-split lines of Fe(3+) ions, (FeI)(3+) which are present in regular oxygen octahedra and (FeII)(3+) which are associated with oxygen vacancies. From the magnetic measurements, Neel temperatures in the SrFe(x)Mn(1-x)O(3y) were found to be TN = 130 K, 35 K and 20 K for x - 0.7, 0.5 and 0.4, respectively. Using the experimental data of the densities, the Mossbauer effect and effective magnetic moments, discussions concerning the amount of oxygen vacancies in the perovskite compounds are given. The perovskite-like phases exhibited semiconducting behavior with activation energies of about 0.16 eV, which was almost independent of composition. Author

N72-30700 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.
La(x)Sr(1-x)RuO3: A NEW PEROVSKITE SERIES
R. J. Bouchard and J. F. Weiher *In* NBS Solid State Chem. Jul. 1972 p 275-284 refs (For availability see N72-30680 21-26)

The compound LaRuO3 was prepared for the first time. It appears to be metallic and antiferromagnetic. Solid solutions with ferromagnetic SrRuO3 of the type La(x)Sr(1-x)RuO3 exist for all values of x. All compounds have the orthorhombic GdFeO3-type perovskite structure. The ferromagnetism observed for SrRuO3 (x = 0) diminishes rapidly with increasing La content, and antiferromagnetism or parasitic ferromagnetism sets in at approximately 35% La. All compounds show Curie-Weiss behavior at fairly low temperatures. The properties of LaRhO3 are also discussed. Author

N72-30701 Bell Telephone Labs., Inc., Murray Hill, N.J.
HIGH PRESSURE SYNTHESIS AND CRYSTAL STRUCTURE OF COBALT SESQUIOXIDE AND ITS LOW-SPIN TO HIGH-SPIN TRANSITION
M. Marezio, P. D. Dernier, J. Chenavas (CNRS, Grenoble, France), and J.-C. Joubert (CNRS, Grenoble, France) *In* NBS Solid State Chem. Jul. 1972 p 285-286 (For availability see N72-30680 21-26)

This note reports the high pressure synthesis of Co2O3 with the corundum structure. Two different syntheses were performed. In the first the starting material was Co(2+)Cr(6+)O4. By applying a pressure of equal to or greather than 90 kbar and 1000 C in the presence of a small amount of water, CoCrO4 was found to decompose in Co2O3 with the corundum structure and a solid solution of CoOOh and CrO2 with the orthorhombic distortion of the rutile structure. The decomposition formula is given. The second synthesis was based on the following reaction at 80 kb and 850 C:2 CoF3 +3 Na2O2 yields 6 NaF + Co2O3 +3/2O2. Author

N72-30702 Lincoln Lab., Mass. Inst. of Tech., Lexington.
INFLUENCE OF MADELUNG ENERGY AND COVALENCY ON THE STRUCTURE OF A(PLUS)B(5 PLUS)O3 COMPOUNDS
J. A. Kafalas *In* NBS Solid State Chem. Jul. 1972 p 287-293 refs Sponsored by Air Force (For availability see N72-30680 21-26)

The large Goldschmidt tolerance factor t = 1.06 in BaTiO3 appears to be related to its ferroelectric properties and also suggests that relatively large effective charge at a Ti(4+) ion inhibits formation of the hexagonal-perovskite polytypes generally associated with t > 1.0. In order to test these ideas, RbNbO3 and RbTaO3 (t = 1.08) were prepared under very high pressures. RbNbO3 is an orthorhombic perovskite isostructural with ferroelectric BaTiO3, and it decomposes on heating without formation of an hexagonal-perovskite polytype. Only at 90 kbar and 900 C did RbTaO3 form a cubic, or nearly cubic, perovskite. Unlike the transition-metal ions, Sb(5+) and Bi(5+) have never been stabilized in a cubic perovskite structure. AgSbO3 forms a defect pyrochlore, NaSbO3 and KSbO3 have ilmenite structures, although a cubic (Pn3) form of KSbO3 is stabilized by prolonged annealing above 1000 C. A body-centered-cubic, disordered form of the cubic KSbO3 having space group I23 was prepared in five minutes at 20 kbar and 800 C. Preparation of RbSbO3 at 20 kbar and 1000 C yielded a phase with the same structure. These results are interpreted to mean that strong covalent bonding inhibits the formation of 180 Sb(5+)-O(2-)-Sb(5+) linkages. Author

N72-30703 Oxford Univ. (England). Inorganic Chemistry Lab.
DEFECTS IN OXIDES
J. S. Anderson *In* NBS Solid State Chem. Jul. 1972 p 295-317 refs (For availability see N72-30680 21-26)

Defects in ionic crystals, such as the metallic oxides, are so intimately involved in diffusion, reactivity and electronic properties, that an understanding of defect structure is a necessary background for a variety of problems in the chemistry, physics and technology of materials. Consideration is restricted primarily to thermodynamic defects: the inner equilibrium of oxide structures, stoichiometric changes that displace that equilibrium, and solid solutions in which replacement of one cation by another of different valence involves an analogous change in the ratio of cations to anions in the crystal structure. This paper is largely concerned with structural matters and has two purposes: the first is to draw together what is known about highly defective oxide structures (stoichiometrically variable and solid solution phases); the second is to consider, in more detail, one or two systems that exhibit a remarkable capacity for organizing their defect structures. Author

N72-30704 Battelle-Northwest, Richland, Wash. Fuels and Materials Dept.
OXYGEN DISSOCIATION PRESSURES AND PHASE BEHAVIOR IN THE TRANSPLUTONIUM OXIDES
T. D. Chikalla and R. P. Turcotte *In* NBS Solid State Chem. Jul. 1972 p 319-330 refs (For availability see N72-30680 21-26)
(Contract AT(45-1)-1830)

The results of recent oxygen vapor pressure measurements over nonstoichiometric AmO(x) CmO(x) and BkO(x) are presented. These include derived information concerning the phase relations and partial thermodynamics of oxygen solution over the range 1.5 < x < 2.0 and 300 < T < 1200 C. The americium-oxygen system was examined by thermogravimetric techniques in the single phase alpha region for 1.80 < x < 2.00 to yield relative partial molar heat and entropy data. Supporting information obtained by quench methods and X-ray diffraction analysis extend the results to lower compositions and, additionally, demonstrate the existence of a bcc sigma phase over a wide composition range. Phase relations in the curium-oxygen system have been defined by a series of isobars in the pressure range 2 < PO2 (mm) < 730. In addition to alpha and sigma phase, compounds of more narrow compositional width are seen at CmO(1.72) and CmO(1.82), and a plausible phase diagram is constructed. Differences obtained on two curium isotypes of greatly different radioactivity are discussed. The berkelium-oxygen system has been examined using a novel capacitance manometer system and a 1.2 mg sample. A set of five isotherms was obtained over the range 852 < T (C) < 1150. The isotherms show a regular variation across alpha and sigma regions separated by a diphasic field at x is approximately 1.79. In addition, a narrow two-phase region exists between BkO(1.91) and BkO(1.93). Certain similarities are shown to exist between this and certain other fluorite related ternary oxide systems. In addition, melting behavior of the di- and sesquioxides and polymorphism in the sesquioxide is described over the entire actinide series. Author

N72-30705 Oak Ridge National Lab., Tenn.
BINARY SOLID SOLUTIONS OF PaO2 AND OTHER ACTINIDE DIOXIDES AND THEIR EXCHANGE EQUILIBRIA WITH MOLTEN SALT REACTOR FLUORIDES
C. E. Bamberger, R. G. Ross, and C. F. Baes, Jr. *In* NBS Solid State Chem. Jul. 1972 p 331-341 refs Sponsored by AEC (For availability see N72-30680 21-26)

The dioxides are studied of thorium, protactinum, uranium and plutonium are relatively insoluble in molten mixtures containing LiF, BeF2, ThF4, PaF4, and UF4 or UF3 which serve as the fuel of the molten salt nuclear power reactors (MCR's). Since these dioxides can form substitutional solid solutions, exchange reactions involving the solid solution and the molten fluoride phase become possible. It is of interest to study such exchange equilibria not only because the inadvertent precipitation of fissile oxide solids from an MSR fuel should be avoided, but also because such reactions might provide a means of separating and recycling the fissile and fertile elements. A study of the exchange reaction involving Pa(4+) and Th(4+) has been carried out in which PaO2-ThO2 solid solutions were formed by equilibration of ThO2 with molten LiF-BeF2-ThF4-PaF4 (72-16-12-0.05 mol %) in the temperature range 570-730 C. Author

N72-30706 Arizona State Univ., Tempe. Dept. of Chemistry.
GROWTH AND X-RAY STUDIES OF SINGLE CRYSTALS OF HIGHER OXIDES OF PRASEODYMIUM AND TERBIUM
M. Z. Lowenstein, L. Kihlborg, K. H. Lau, J. M. Haschke, and L. Eyring *In* NBS Solid State Chem. Jul. 1972 p 343-351 refs Sponsored by AEC (For availability see N72-30680 21-26)

Single crystals of the higher oxides of praseodymium and terbium have grown successfully using hydrothermal techniques. Cold seal reactors were utilized to study the crystallization process over a temperature range of 600-900 C and at pressures up to 3.1 kilobar. Crystal growth conditions were optimized using controlled pressure and temperature cycling. Any oxide of praseodymium may be used as starting material. Nitric acid served both as a mineralizer to promote solubility and as a source of oxygen. Two predominant crystal habits are observed;

octahedra and trigonal prisms. The faces are smooth and well defined. Single crystals of praseodymium dioxide have been reduced to PrO(1.833) in the homologous series Pr(n)O(2n-2) with crystal integrity maintained. X-ray data have been obtained on these crystals using Weissenberg and Hagg-Guinier cameras. The phase has a fluorite-type sublattice with a superstructure of monoclinic symmetry and a unit cell having a = 6.6874 A, b = 11.602 A, c = 15.470 A, beta = 125.257 and v = 979.6 A. Indexing of the powder pattern of this phase has been completed on the basis of this cell. The relationship to the fluorite subcell is shown. Author

N72-30707 Columbia Univ., New York. Henry Krumb School of Mines.
DEFECTS AND MASS TRANSPORT IN REDUCED CeO2 SINGLE CRYSTALS
Y. Ban and A. S. Nowick *In* NBS Solid State Chem. Jul. 1972 p 353-365 refs Sponsored by ARPA (For availability see N72-30680 21-26)

A study is made of reduced CeO2 in the form of large single crystals grown by arc fusion. It is shown that, so long as y is equal to or greater than 1.67 in the formula CeOy, all structural changes on reducing CeO2 occur without loss of coherency of the original fluorite lattice. Comparison of length and lattice parameter changes shows that only oxygen vacancies (and no detectable Ce interstitials) are present in the reduced state. For y > 1.67, it is shown that oxidation (in air or in O2) takes place at reasonable rates just above room temperature. The kinetics of this anomalously rapid mass transport are studied in some detail, including the effects of sample thickness and of oxygen partial pressure. The results show that the kinetics are neither diffusion nor surface controlled. A model of the process is developed which explains the major results. The low temperature oxidation process does not terminate in the pure alpha (CeO2) phase, but in a metastable structure, here called alpha prime, for which y is very close to 2.0. The properties of alpha prime are discussed. Author

N72-30708 Centre National de la Recherche Scientifique, Bellevue (France). Lab. des Terres Rares.
ANION CENTERED COORDINATION POLYHEDRA AND RELATED PHYSICAL PROPERTIES IN RARE EARTH OXIDES AND OXYSALTS
Paul E. Caro *In* NBS Solid State Chem. Jul. 1972 p 367-383 refs (For availability see N72-30680 21-26)

The structures of rare earth oxides and oxysalts are described in terms of linkages of anion centered coordination polyhedra namely tetrahedra, yielding two-dimensional or three-dimensional frameworks. A complex lanthanyl cation can be recognized. It has two different arrangements of tetrahedra, one of them being identical with the well known Bismuthyl cation. The structural elements are similar to the classical SiO2 and Si(x)O(y) ones; SiO4 tetrahedra frameworks, used for silicates structures classification. Other anions than oxygen (sulfur and halides) yield isomorphous networks. Such types of structures imply some sort of covalent bonding. The covalence of the bond can be shown from optical measurements on solids. For (OLn4) compounds the absorption spectrum is displaced to the red (nephelauxetic effect), a phenonmenon which corresponds to the lowering of the Racah's parameters of the 4 f sup n configuration. The mixing of its wave functions with ligand wave functions also yields larger transition probabilities and the Lanthanyl cation materials are very effective phosphors. The layered oxide structures also yield textured thin films which exhibit epitaxial continuity and intergrowth between the rare earth oxides phases. Author

N72-30709 Cornell Univ., Ithaca, N.Y. Baker Lab. of Chemistry.
PLASMA-SYNTHESIZED SUBSTOICHIOMETRIC SCANDIUM OXIDE
J. E. Young, Jr. and M. J. Sienko *In* NBS Solid State Chem. Jul. 1972 p 385-395 refs Sponsored by AFOSR and ARPA (For availability see N72-30680 21-26)

Crystals of substoichiometric scandium oxide have been grown in high frequency, induction-coupled, argon plasmas. The composition of the crystals were varied by addition of small percentages of hydrogen or oxygen to the argon stream. Chemical analysis by reoxidation indicated an oxygen deficiency that could attain 4% before metallic films appeared, concentrated at grain boundaries. The chemical composition of the films could not be established. X-ray studies of the bulk crystals indicated retention of the C-type rare earth structure of Sc2O3 with but slight shrinkage of the cubic cell parameter. Transmission electron microscopy showed no evidence for shear plane formation. Attempts to measure Hall voltage and conductivity by a van der Pauw technique gave conductivity values, both ac and dc, too small to measure. Faraday susceptibility measurements from 1.6 to 300 K indicated a very small effective magnetic moment, which decreased below 10 K. Possible models are F and F prime centers in thermal equilibrium or Sc(+1) ions with thermal equilibrium between D3 and D1 or D3 and S1 states. Author

N72-30710 Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY AND COMPOUND FORMATION IN THE SYSTEMS RARE EARTH SESQUIOXIDE-WO3
G. J. McCarthy, R. D. Fischer, G. G. Johnson, Jr., and C. E. Gooden *In* NBS Solid State Chem. Jul. 1972 p 397-411 refs (For availability see N72-30680 21-26)

Compounds with the following stoichiometries have been prepared in the rare earth sesquioxide-tungsten trioxide systems: RE6WO12, RE10W2O21, RE14W4O33, RE2WO6, RE2W2O9. Compounds of the first three stoichiometries prepared at 1400 C have structures apparently related to that of fluorite. RE6WO12 has three structural classes whose symmetries are dependent on the rare earth ionic radius: La-Pr, cubic or pseudocubic; Nd-Gd, pseudotetragonal; Tb-Lu, Y, rhombohedral. RE10W2O21 is stable only for RE = Gd-Ho, Y and has the same pseudotetragonal symmetry as the intermediate RE6WO12 compounds. RE14W4O33 has a pseudorhombohedral structure related to the third RE6WO12 structure. The rhombohedral RE6WO12 compounds are known to be isostructural with RE7O12 oxides and it is suggested that RE10W2O21 and RE14W4O33 may be structurally related to RE4O7 and RE6O11 respectively. RE2WO6 compounds with RE = Pr-Dy have a monoclinic scheelite-related structure. The RE2W2O9 compounds, also with a complex monoclinic structure, are stable only for RE = Ce=Gd (or Tb). Compounds of the stoichiometries RE4W3O12 and RE2W3O12 were not studied, but the literature information on them is noted. A discussion of the probable sub-solidus phase relations in RE-W-O systems is also included. Author

N72-30711 Muenster Univ. (West Germany).
PREPARATION OF OXIDES AND RELATED COMPOUNDS BY CHEMICAL TRANSPORT
Harald Schaefer *In* NBS Solid State Chem. Jul. 1972 p 413-436 refs (For availability see N72-30680 21-26)

Reversible heterogeneous reactions which are utilized in chemical transport are studied. The phenomenon is complex but can normally be treated as gaseous diffusion between spaces in which thermodynamic equilibrium has been established between solid and gaseous phases. The partial pressure drop between these spaces is the quantity which determines the suitability of a chemical reaction for transport processes. In addition there is an account of the binary oxides which have been chemically transported up to now and there is an account of the types of reaction used for transport. Using zinc oxide transport as an example, a demonstration is given of the selection of transport reactions on the basis of thermodynamic considerations. Syntheses are discussed in a temperature gradient and in solid/solid reactions, with regard to the preparative employment of chemical transport processes. This discussion is illustrated with several examples. Examples are given of the crystallization of metastable modifications out of the gas phase. Author

N72-30712 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.
PRECISION PARAMETERS OF THE FERROELECTRIC RARE EARTH MOLYBDATES Ln2(MoO4)3
L. H. Brixner, P. E. Bierstedt, A. W. Sleight, and M. S. Licis *In* NBS Solid State Chem. Jul. 1972 p 437-443 refs (For availability see N72-30680 21-26)

Lattice parameters to an accuracy of better than + or - 0.001 A have been determined for the ferroelectric Ln2(MoO4)3 compounds with Ln = Pr, Nd, Sm, Eu, Gd, Tb, Dy and Ho. X-ray patterns were obtained with a Hagg-Guinier camera and the data was refined by a least-squares method using selected reflections. Parameters obtained this way exhibited a systematic trend of the b-a dimension as a function of the cation size for the orthorhombic Pba2 room temperature structure. A linear relationship between the cell volume and the cube of the ionic radius of the rare earths has been observed. The first seven compounds are metastable at room temperature and transform from the ferroelectric/ferroelastic Pba2 structure to the parent P42 sub 1m structure between 140 and 235 C. Only Ho2(MoO4)3 is stable in the Pba2 phase at room temperature and transforms into the tetragonal structure at 121 C. The high temperature structure for this compound is orthorhombic, space group Pnca. The transition temperatures have been accurately determined by differential scanning calorimetry, differential thermal analysis, dielectric measurements and hot-stage optical techniques and are discussed in relationship with the degree of b-a distortion. Lattice parameters have also been determined for the stable monoclinic modification of Sm, Eu, Gd, Tb and Dy-molybdate and their transition temperatures, ranging from 800 to 1000 C, as reported. Author

N72-30713 Bell Telephone Labs., Inc., Murray Hill, N.J.
STRUCTURAL AND PHASE RELATIONSHIPS AMONG TRIVALENT TUNGSTATES AND MOLYBDATES
K. Nassau and J. W. Shiever *In* NBS Solid State Chem. Jul. 1972 p 445-456 refs (For availability see N72-30680 21-26)

The trivalent tungstates L2(WO4)3, molybdates L2(MoO4)3, and mixed systems, L2(W(1-x)Mo(x)O4)3 were studied between room temperature and the melting points (up to 1650 C). Single crystal and powder X-ray diffraction at room and elevated temperatures, differential thermal analysis, and crystal growth were among the techniques used to characterize phases and determine relationships. Among the molybdates of the lanthanides, In, Sc, Fe, Cr, and Al, at least five structures were observed: the tungstates show at least three. Particular attention was devoted to Tb2 (MoO4)3, which, like Gd2(MoO4)3, shows transitions at 800, 1040 and melting at 1155 C and a ferroelectric transition at 163 C in the metastable phase region; not all of these transitions are easily reversible. Pseudo-binary tungstate-molybdate phase diagrams and structural parameters were determined for the La, Nd, Sm, Gd, Ho, and In systems. Based on structural determinations together with phase diagram interpretations and crystal growth evidence on the nature of various transitions (destructive or nondestructive), structural relationships were used to organize the many structures into three groupings and relate the results to the radii of the trivalent atoms. Author

N72-30714 Aberdeen Univ. (Scotland). Dept. of Chemistry.
CRYSTAL CHEMISTRY OF TETRAHEDRALLY-COORDINATED OXIDES: Li3PO4 DERIVATIVES
A. R. West and F. P. Glasser *In* NBS Solid State Chem. Jul. 1972 p 457-469 refs (For availability see N72-30680 21-26)

Tetrahedrally-coordinated oxides are readily synthesized by direct solid state reaction of the constituent oxides or by hydrothermal reaction. The intermediate phases often undergo further structural distortion during quenching to ambient. Li3PO4 itself forms an intermediate phase in the conversion low to high Li3PO4. This intermediate phase is readily retained to ambient but is believed to be metastable at all temperatures. More complex Li3PO4 derivatives include substances of the general formula Li2MXO4, where M = Mg, Zn, Co(2+) and X = Si, Ge(++). Each compound usually has at least two polymorphs. These fall into three classes: one which is either high or low Li3PO4 type, one which includes the distortional derivatives of both high and low Li3PO4, and lastly, phases of related but unknown structures. A full explanation of the polymorphism of an individual phase is only possible if effects due to solid solution are taken into account. Author

N72-30715 Centre National de la Recherche Scientifique, Odeillo (France). Lab. des Ultra Refractaires.
ON THE SOLIDIFICATION TEMPERATURE AND THE NONSTOICHIOMETRY OF COBALTOUS OXIDE IN AN OXIDIZING ATMOSPHERE
J. P. Coutures and M. Foex *In* NBS Solid State Chem. Jul. 1972 p 471-481 refs (For availability see N72-30680 21-26)

Liquid cobaltous oxide can dissolve a large amount of oxygen depending on temperature, oxygen partial pressure, and time. Therefore, the solidification temperature decreases when the amount of oxygen in the liquid phases increases. During solidification, a spitting phenomena occurs. The behavior (spitting phenomena for example) and the properties of this oxide (solidification temperature, melt composition, solid composition) are studied by high temperature techniques. Author

N72-30716 Wien Univ. (Austria).
CARBIDES AND SILICIDES
Hans Nowotny, H. Boller, and G. Zwilling *In* NBS Solid State Chem. Jul. 1972 p 487-504 refs (For availability see N72-30680 21-26)

A brief survey of the structural chemistry of transition element carbides is presented with emphasis on the problem of carbon-void ordering. The scandium carbides including Sc15C19 are discussed. Complex carbides which derive from octahedral and trigonal prismatic building elements are classified. Metal-metal carbides such as VCr2C2 and metal-nonmetal carbides such as Ti2SiC2, V4P2C, Nb2SC or Ta2S2C are interrelated. The role of nitrogen and hydrogen on the stabilization of complex carbides such as Cr3(C,N)2 or Zr2CH(0.5) is also treated. Besides the class of typical interstitial carbides, some examples of metal boro-carbides displaying a two-dimensional boron-carbon network are given (YB2C). In compounds such as Cr2(P,C) carbon plays an intermediate role. The present state of the problem of chemical bonding in carbides is discussed.
Author

N72-30717 Wien Univ. (Austria). Inst. fuer Chemische Technologie Anorganischer Stoefe.
INVESTIGATIONS IN THE TERNARY SYSTEM BORON-CARBON-SILICON
E. Gugel, R. Kieffer, G. Leimer, and P. Ettmayer *In* NBS Solid State Chem. Jul. 1972 p 505-513 refs (For availability see N72-30680 21-26)

The system boron-carbon-silicon was investigated by chemical and X-ray analysis. In the binary system, compositions of 0 to 60% C, 100 to 40% B in the temperature range 1800 to 2300 C were studied along with the ternary system B-Si-C. It was found that in the B-C system, the only compound is B4C with a relatively wide range of composition. with increasing substitution of carbon atoms by boron, an increase of the lattice occurs. The liquidus curve of this system has a maximum at 16% C. The eutectic between B4C and C lies at 26% C at 2400 C. In the ternary system B-Si-C no indication of the existence of a ternary compound could be found. F.O.S.

N72-30718 Naval Research Lab., Washington, D.C.
VALENCE BONDING IN SOME REFRACTORY TRANSITION METAL COMPOUNDS WITH HIGH COORDINATION
Forrest L. Carter *In* NBS Solid State Chem. Jul. 1972 p 515-559 refs (For availability see N72-30680 21-26)

Bond formation in transition metal compounds isomorphous with WC and AlB2 is formulated using the bidirectional orbital approximation to establish orbital hybridization and a simple but self-consistent application of Pauling's metallic radii with charge

transfer to obtain the bond orders. For tungsten carbide seven mutally orthogonal bidirectional bonding orbitals for the negative W atom permits it to simultaneously bond its fourteen neighbors with up to 6.5 electrons. However, bond polarization results in an effective negative charge for carbon of 0.0 to -0.3e. For the diborides the metallic radii results indicate that the group 4 diborides have a slightly positive boron which becomes negative with increasing group number but remains below a charge of -1e. Four arguments are given for the pleating of the boron layer were it to be heavily charged as has been proposed earlier in the isoelectronic analogy to graphite. One of these involves a new definition of atomic volume based on the Voronoi polyhedron. Bond formation by the boron and carbon atoms in these compounds is discussed using the nonpaired spin-orbital approach of Linnett. Author

N72-30719 Los Alamos Scientific Lab., N.Mex.
CRYSTAL CHEMISTRY OF REFRACTORY CARBIDES
Allen L. Bowman *In* NBS Solid State Chem. Jul. 1972 p 561-566 refs Sponsored by AEC (For availability see N72-30680 21-26)

The crystal structures of most of the refractory metal carbides may be described generally on the basis of a close-packed metal sublattice, with the carbon atoms occupying all or part of the octahedral sites. Close-packed carbide structures have been observed with composition MC and packing type c, M4C3 and hhcc, M3C2 and hcc or hhc, and M2C and h or c. All of these structures have one octahedral site per metal atom, and thus an apparent possible composition MC. This is reached however, only with the c-type packing, and it has been suggested that only one half of the sites adjacent to an h layer can be filled. This is found to be an upper limit that is not always reached. These carbide structures have carbon vacancy concentrations ranging from approximately 0 to 70%, with a possibility of vacancy ordering. Neutron and electron diffraction studies have shown ordering to exist in the M2C compounds and in carbon-deficient VC. The order-disorder transformation of the carbon vacancies in Mo2C has been studied in detail with high-temperature neutron diffraction. The kinetics data are consistent with a nucleation-growth mechanism involving nucleation on grain boundaries and linear growth across the interface. The reaction between Mo2C and Mo3C2, involving the transformation of the close-packed metal lattice (h reversible reaction hcc) has been studied less thoroughly, but the kinetics data also appear to be consistent with a nucleation-growth mechanism. Author

N72-30720 Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
A SIMPLE MODEL FOR THE STABILITY OF TRANSITION METAL CARBIDES
Robert G. Lye *In* NBS Solid State Chem. Jul. 1972 p 567-582 refs (For availability see N72-30680 21-26)

The similarity of the properties of transition metal carbides to the parent transition metal are studied. This characteristic of the carbides is considered briefly in the present study in an attempt to provide a qualitative explanation for the manner in which the stability of the carbide phases varies with the position of the parent metal in the periodic chart of the elements. A simple model for the d band bonding in the transition metals, discussed by Cyrot-Lackmann, is modified for this purpose. In particular, it is assumed that a major component of the bonding in the carbides arises from crystalline electronic energy bands derived from the d states of the metal atoms. Because of changes in crystal structure, these bands are modified somewhat from the shape of the corresponding bands in the parent metal. Of greater importance for the stability of the carbides, however, is the increase in the width of the band, discussed by Costa and Conte, that results from the presence of the carbon atoms within the interstitial positions in the metal sublattice. As for the parent metals, the cohesion of the carbides is determined by the number of electrons in the d band. In the carbides, however, it is assumed that some of these electrons are provided by transfer from the 2p states of the carbon atoms. Thus, the stability, as measured by the heat of formation, results from the combined effects of the increase in the width of the d band and in the number of electrons it contains. Despite the considerable simplifications employed, an analytical formulation of this model yields estimates for the heats of formation of the carbides that agree remarkably well with the experimental data presently available. Author

N72-30721* Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
ORDERING EFFECTS IN NbC AND TaC
J. D. Venables and M. H. Meyerhoff *In* NBS Solid State Chem. Jul. 1972 p 583-590 refs (For availability see N72-30680 21-26)
(Contract NASw-1290)
CSCL 20B

By means of transmission electron microscopy and electron diffraction, evidence has been obtained for the existence of long range carbon atom ordering in single-crystal niobium carbide that has a carbon-to-metal ratio close to the integral composition Nb6C5. The ordering, which gives rise to superlattice and domain structures similar to those observed in V6C5, appears, however, only in samples that have been cooled slowly through the order-disorder temperature of 1025 C. In TaC of similar composition, the ordering, although present, remains very imperfect even after the crystals are subjected to the same thermal treatment. The results are interpreted in terms of the electronic structure of the transition metal carbides as it is currently understood, and their relevance to the mechanical properties of NbC and TaC are discussed. Author

N72-30722 Bell Telephone Labs., Inc., Murray Hill, N.J.
THE CdP2-Ge SYSTEM AND THE GROWTH OF CRYSTALS OF CdGeP2
E. Buehler and J. H. Wernick *In* NBS Solid State Chem. Jul. 1972 p 591-595 refs (For availability see N72-30680 21-26)

The macroscopic features of the phase relationships in the CdP2-Ge system have been determined. The tetragonal CdGeP2 phase melts congruently at 790 plus or minus 5 C. Two eutectics are present: one between CdP2 and GdGeP2 at approximately 700 C and 20 mol percent Ge, and the other, between CdGeP2 and Ge at approximately 750 C and 65 mol percent Ge. Techniques and results for the growth of crystals from stoichiometric melts, by chemical transport, and from liquid Cd and Sn are presented. Author

N72-30723 Pennsylvania State Univ., University Park. Materials Research Lab.
HIGH BORON CONTENT RARE-EARTH BORIDES
K. E. Spear and G. I. Solovyev *In* NBS Solid State Chem. Jul. 1972 p 597-604 refs (For availability see N72-30680 21-26)

Investigations were performed to determine which rare-earth metals form LnB66 phases, and to measure some of the properties of these compounds. Similar rare-earth borides have been recently reported with B:Ln ratios of 50 to 100 for metals Y, Gd, Tb, Ho, and Yb. A single crystal structure analysis published on the yttrium compound shows the structure to be face-centered cubic with an ideal stoichiometry Yb66. In the present studies, ten representative metals were used:Y, La, Ce, Pr, Nd, Sm, Gd, Dy, Er, and Yb. Boron-rich compositions were prepared by arc-melting mixtures of the elements. Identification of the phases in each sample was performed with the use of X-ray and metallographic techniques. All of the investigated systems except La, Ce, and Pr formed the LnB66 phase, and it is predicted that all rare-earth metals from Nd through Lu will form this phase. Lattice parameters were measured and show a general, but not regular decrease with atomic number. Author

N72-30724 Air Force Materials Lab., Wright-Patterson AFB, Ohio.
PREPARATION AND CHARACTERIZATION OF BORON SUBOXIDE
D. R. Petrak, Robert Ruh, and B. F. Goosey *In* NBS Solid State

Chem. Jul. 1972 p 605-611 refs Prepared in cooperation with Cincinnati Univ., Ohio (For availability see N72-30680 21-26)

Fabrication techniques have been developed to produce specimens of near theoretical density by reaction hot pressing of boron and boric acid in vacuum at temperatures of 1900 to 2000 C and pressures of 0.41 kilobars. The composition range 80 to 89 atomic boron was investigated by chemical analysis, lattice parameter studies, pycnometric density determinations, electron probe analysis, and infrared analysis. The boron suboxide phase has been studied by electron probe and infrared analyses. The oxygen K emission spectra as well as the infrared reflection spectra are presented. Boron suboxide has been studied by mass spectrometric analysis and found to decompose to rhombohedral boron and B2O2. Author

N72-30725 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Central Research Dept.

TERNARY TRANSITION METAL SILICIDES AND GERMANIDES: ORDERING AND METAL-METAL BONDING IN Ni2In-RELATED PHASES

Vancliff Johnson and Wolfgang Jeitschko *In* NBS Solid State Chem. Jul. 1972 p 613-622 refs (For availability see N72-30680 21-26)
(Contrib-1879)

Ternary transition metal silicides and germanides with structures related to Ni2In are reviewed. For compositions TT'Si and TT'Ge, where T is a transition metal from groups IV, V and VII and T' is from the iron group, the structures adopted are TiNiSi (ordered anti-PbCl2), ordered Fe2P, TiFeSi or Ni2In. How these as well as the hexagonal Mn5Si3 structure are related is described. Metal site occupancies in ternary TiNiSi and Fe2P-type silicides and germanides and pseudobinaries with Ni2In and Mn5Si3 structures are also reviewed. The importance of the relative size and electronegativity of the transition metal atoms and their d-electron configurations in determining site references is analyzed. Bonding in Ni2In-related phases is discussed. The structures differ principally in the strengths of the respective T-T, T-T', and T'-T' metal-metal interactions. Questions as to how these are determined by electronegativities, size and d-electron configuration, and how they in turn affect phase stability and metal-site occupancies are raised. Author

N72-30726 Groningen Rijksuniversiteit (Netherlands). Lab. voor Anorganische Chemie.

STRUCTURAL TRANSITIONS OF SOME TRANSITION METAL CHALCOGENIDES

F. Jellinek *In* NBS Solid State Chem. Jul. 1972 p 625-635 refs (For availability see N72-30680 21-26)

A survey is given of some recent investigations on transition-metal chalcogenides (sulfides, selenides, tellurides). Particular attention is paid to compounds undergoing structural transitions at elevated temperatures. Examples are given to transitions involving a change of the coordination of the metal (NbSe2, TaS2, TaSe2, MoTe2; Ni3Se2), of order-disorder transitions (AgCrSe2) and related compounds; and of transitions involving distortions of the structure (CrS; VS, Nb(1-x)s). The occurrence of trigonal-prismatic coordination in several transition-metal chalcogenides is ascribed to d-covalency which stabilizes trigonal-prismatic with respect to octahedral coordination for ions with a d(0), d(1) or spin-paired d(2) configuration. The effect of the metal coordination on the physical properties of the compound is also described. The distributions of occupied and vacant metal sites in transition-metal chalcogenides M(1+p)X2 are discussed (chromium sulfides, zirconium selenides), as is the concept of occupation waves (titanium sulfides). In Ni(3+x)Te2 occupation waves lead to a phase lacking three-dimensional periodicity; the intervention of this phase allows smooth transitions from the disordered high-temperature form to the ordered low-temperature forms (two-step second-order transition).
Author

N72-30727 IBM Watson Research Center, Yorktown Heights, N.Y.

SOLID SOLUBILITY IN THE FACE CENTERED CUBIC Gd(x)Se(1-x)

F. Holtzberg, D. C. Cronemeyer, T. R. McGuire, and S. VonMolnar *In* NBS Solid State Chem. Jul. 1972 p 637-644 refs (For availability see N72-30680 21-26)
(Contract DAAH01-71-C-1319)

The range of homogeneity has been studied in the face centered cubic Gd(x)Se(1-x) system. The solid solution field is bounded by the composition x = 0.443 for excess Se and extends through the stoichiometric composition to at least 0.512 for excess Gd. The lattice constant decreases linearly with decreasing Gd concentration except at lowest values of x. The materials have been characterized by resistivity, reflectivity and magnetic measurements. The results of the transport and reflectivity measurements are explained on the basis of a simple single rigid band model. Magnetization measurements show that all compositions order antiferromagnetically with the Neel temperature, T sub N, varying from approximately 20 to 60 K and theta from -25 to -135 K with increasing Gd or electron concentration. Author

N72-30728 Paris Univ. (France). Lab. de Chimie Minerale et Lab. de Physique.

TERNARY CHALCOGENIDES OF LIGHT RARE EARTH ELEMENTS WITH TRANSITION ELEMENTS

G. Collin, H. D. Nguyen, O. Gorochov, M. Guittard, P. Laruelle, and J. Flahaut *In* NBS Solid State Chem. Jul. 1972 p 645-650 (For availability see N72-30680 21-26)

Three kinds of new compounds which contain transition elements of iron and chromium as well as light lanthanides are described. The compounds are identified as: (1) La2Fe2S5, (2) La8Fe3S15, and (3) LaCrSe3. The crystal structures were established with single crystals before the magnetic and electrical properties were determined. Diagrams of the atomic structure of the compounds are included. Author

N72-30729 Iowa State Univ. of Science and Technology, Ames. Inst. of Atomic Research and Dept. of Chemistry.

CRYSTAL CHEMISTRY OF METAL-RICH REFRACTORY SULFIDES

Horng-yih Chen and Hugo F. Franzen *In* NBS Solid State Chem. Jul. 1972 p 651-662 refs Sponsored by AEC (For availability see N72-30680 21-26)
(Contrib-3127)

Systematization of the crystal structures of metal-rich chalcogenides was attempted with emphasis on the coordinations of a few key metal atoms. This approach gave a more complete interpretation of many chalcogenide structures, notably those of Ta2S, Ta6S and Nb2Se, than did the conventional descriptions using the packing of the coordinations of the chalcogen atoms. The pursuit of this approach led to the recognition of a polyhedron, which, owing to its repeated presence in many metal-rich compounds, appeared to be of great importance in crystal chemistry. It is a two-centered polyhedron formed by the interpenetration of two C. N. 14 Kasper polyhedra in such a way that the center of one of the Kasper polyhedra is the apex of another. The presence of a very short interatomic distance between the two centers is one of the important features of this polyhedron. With the help of this polyhedron as the building block, the structures of Zr9S2, alpha-V3S and beta-V3S were satisfactorily described and correlated; the short interatomic distances in the structures could be explained semi-quantitatively, and the structural differences expressed by the different packing schemes of the polyhedra and the different positions the sulfur atoms occupied in the polyhedra. Author

N72-30730 Minnesota Univ., Minneapolis. Dept. of Chemistry.

MIXED CATION DISULFIDES OF TITANIUM, VANADIUM, AND CHROMIUM

Lawrence E. Conroy and Kondayoor Raghavan Pisharody *In* NBS Solid State Chem. Jul. 1972 p 663-670 refs

Sponsored in part by Army (For availability see N72-30680 21-26)

Mixed cation disulfides of the types Ti(1-x)V(x)S2 and Ti(1-x)Cr(x)S2 have been prepared with compositions in the range of x greater than zero and less than one in the Ti-V system and x greater than zero and less than 0.4 in the Ti-Cr system. Polycrystalline materials were prepared by direct reaction of the elements in vacuo at 950 C. Single crystals of the Ti-V compounds were prepared by chemical transport reactions, employing iodine as the transport agent. The Ti-Cr disulfides failed to transport by this technique. The chemical properties of the mixed cation materials were found to be very similar to those in the TiS2. X-ray diffraction data indicated a random substitution of V or Cr for Ti in the normal Ti sites in the TiS2 structure. Author

N72-30731 Bell Telephone Labs., Inc., Murray Hill, N.J.
CRYSTAL GROWTH AND PROPERTIES OF SOME I-III-VI2 COMPOUNDS
H. M. Kasper *In* NBS Solid State Chem. Jul. 1972 p 671-679 refs (For availability see N72-30680 21-26)

The I-III-VI2 compounds are ternary analogues to the II-VI semiconductors and are interesting both as possible nonlinear optical materials and as semiconductors. In order to study their optical and semiconductor properties, single crystals of AgGaS2, CuGaS2 and CuInS2 have been grown by slowly cooling melts of stoichiometric composition, and the conditions of growth by directional freezing are reported. AgGaS2 crystallizes as yellow and green crystals. The yellow crystals seem to be gallium rich. CuGaS2 does not melt congruently. Stoichiometric melts first crystallize as light orange crystals. Later darker, nearly stoichiometric crystals are obtained. CuInS2 crystallizes between 1050 C and 1000 C. Author

N72-30732 Texas Univ., Austin. Materials Science Labs.
CRYSTAL CHEMISTRY AND MAGNETIC PROPERTIES OF PHASES IN THE Ba-Fe-S(Se) SYSTEMS
H. Steinfink, H. Hong, and I. Grey *In* NBS Solid State Chem. Jul. 1972 p 681-694 refs (For availability see N72-30680 21-26)

The crystal structures of several phases synthesized in the Ba-Fe-S and Se systems were investigated by X-ray diffraction techniques. The crystal structure of the compounds is described. The application of three dimensional X-ray diffraction is explained. The magnetic characteristics of Ba2FeS3, Ba7Fe6D14 and Ba6Fe8S15 were investigated and found to be antiferromagnetic. The values of the exchange forces correlate with the observed Fe-Fe distances. Author

N72-30733* Pennsylvania State Univ., University Park. Dept. of Material Sciences.
STUDY OF SULFOSPINELS
R. E. Tressler and V. S. Stubican *In* NBS Solid State Chem. Jul. 1972 p 695-702 refs Sponsored in part by NASA and NSF (For availability see N72-30680 21-26)

Several new compounds with the formula AB2S4 were synthesized. Pressure-induced polymorphism of the sulfospinels was investigated. Sulfospinels which produced new high-pressure phases were NiRh2S4, FeYb2S4, In2S3, CrIn2S4, NiIn2S4, CoIn2S4 and MnIn2S4. The only sulfospinels which transformed to the NiAs derivatives were those in which A and B atoms had unfilled d-orbitals. P-T phase relations were investigated for a series of sulfochromites. Thin films of several ACr2S4 sulfospinels were prepared by a flash evaporization technique on the (111) and (100) planes of NaCl and on the (100) plane of Mgo. Author

N72-30734 Gould, Inc., Cleveland, Ohio.
PHASE CHANGES IN Cu2S AS A FUNCTION OF TEMPERATURE
William R. Cook, Jr. (Case Western Reserve Univ., Cleveland, Ohio) *In* NBS Solid State Chem. Jul. 1972 p 703-712 refs (For availability see N72-30680 21-26)
(Contract F33615-68-C-1732)

Phase changes in copper sulfide as a function of temperature are discussed. The high copper phase boundary of Cu2S deviates from stoichiometery above 300 C, first becoming copper deficient, then above 1075 C becoming copper rich. The strong effect of oxygen on the hexagonal-cubic transition in Cu2S was confirmed. The transition was also found to be sensitive to the type of pretreatment of the material. Author

N72-30735 Brown Univ., Providence, R.I. Div. of Engineering.
PREPARATION AND PROPERTIES OF THE SYSTEMS CuFeS(2-x) AND Cu(1-x)Fe(1 PLUS x)S(2-y)
R. L. Adams, P. Russo, R. J. Arnott, and A. Wold *In* NBS Solid State Chem. Jul. 1972 p 713-719 refs Sponsored in part by Army (For availability see N72-30680 21-26)

Stoichiometric samples of CuFeS2 were prepared by direct combination of the elements in sealed evaluated silica tubes. A description of the products, determined by X-ray diffraction, density determination, magnetic susceptibility, and Mossbauer spectroscopy, is presented. The preparation and characteristics of CuFeS(2-x) are also discussed in the same manner. It was concluded from density measurements that the structure of the sample is best represented by a close packing of sulfur with excess metal ions occupying additional lattice sites. Author

N72-30736 Western Australia Univ., Nedlands. School of Chemistry.
THE TITANIUM AND TITANIUM-CHROMIUM OXIDE SYSTEMS AND SWINGING SHEAR PLANES
L. A. Bursill *In* NBS Solid State Chem. Jul. 1972 p 727-743 refs (For availability see N72-30680 21-26)

An analysis of titanium and titanium-chromium oxide systems and swinging shear planes of the internal structure are discussed. The atomic structure is described by use of a model of the crystalline structure. Photographs of diffraction patterns are presented. Line drawings of the crystal structure are developed to support the theoretical considerations. Author

N72-30737 Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
A DEFECT CLUSTER IN MAGNESIUM FLUOROGERMANATE
E. Kostiner *In* NBS Solid State Chem. Jul. 1972 p 745-748 refs (For availability see N72-30680 21-26)

The analysis of a defect cluster in magnesium fluorogermanate is discussed. The effect of the structure on the fluorescence properties of Mn(+4) is described. Models of the atomic structure of the substance are presented. The procedures for producing the magnesium compounds and conducting the diffraction analysis are analyzed. Author

N72-30738 Flinders Univ., Bedford Park (Australia).
THE ORTHORHOMBIC PHASES IN THE SYSTEM YTTRIUM-OXIDE-FLORIDE
D. J. M. Bevan *In* NBS Solid State Chem. Jul. 1972 p 749-759 refs (For availability see N72-30680 21-26)

The crystal structure and chemical properties of an yttrium oxide-fluoride system are presented. Phase data for samples investigated by powder and single crystal diffraction are tabulated. Graphs of the analyzed and estimated composition are developed. Drawings of the atomic structure of the metal coordination polyhedra are included. Mathematical models are used to support the theoretical considerations. Author

N72-30739 Arizona State Univ., Tempe.
PHASE REACTIONS NOT EXHIBITED ON THE USUAL PHASE DIAGRAM
LeRoy Eyring *In* NBS Solid State Chem. Jul. 1972 p 761-763 refs (For availability see N72-30680 21-26)

The occurrence of hysteresis and pseudo-phase behavior in the two-phase regions of a praseodymium oxide-oxygen system

are examined. The effects of high pressure and temperature on the chemical properties of the system are described. Graphs are developed to show the key temperatures at which phase transformations occur. It is concluded that the tensimetric and gravimetric observations reveal complex behavior associated with coherent intergrowth of neighboring phases of the homologous series resulting in hysteresis and pseudo-phase formation.
Author

N72-30740*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF WORK FUNCTIONS NEAR MELTING POINTS OF REFRACTORY METALS BY USING A DIRECT-CURRENT ARC
William A. Gordon and Gilbert B. Chapman, II Washington Aug. 1972 20 p refs
(NASA-TN-D-6888; E-6896) Avail: NTIS HC $3.00 CSCL 20L

Effective work functions of refractory metals at temperatures near their melting points were determined by using a direct-current arc. A metal wire connected as the cathode was melted by striking an arc discharge in an argon atmosphere. A melted sphere was formed with a definite emitting area which was calculated from the sphere diameter measured after terminating the arc. Effective work functions were calculated from the Richardson-Dushman equation by using this emission area. The procedure is experimentally advantageous because surface cleanliness of the specimen is not critical, high vacuum is not required, and the anode-cathode spacing is not critical. Author

N72-30741*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUANTUM LIMIT STUDIES IN SINGLE CRYSTAL AND PYROLYTIC GRAPHITE
J. A. Woollam, D. J. Sellmyer (MIT, Cambridge), R. O. Dillon (Maryland Univ.), and I. L. Spain (Maryland Univ.) 20 Aug. 1972 10 p refs Presented at 13th Intern. Conf. on Low Temp. Phys., Boulder, Colo., 20-26 Aug. 1972
(Grants NSF GP-21312; AT(40-1)-3782)
(NASA-TM-X-68125) Avail: NTIS HC $3.00 CSCL 20L

The occupied regions of momentum space in graphite are confined to elongated volumes near the hexagonal Brillouin zone edges. The elongation is along the hexagonal axis (c-axis), so that cross sectional areas perpendicular to that axis are very small. When magnetic fields are applied parallel to the c-axis, only the n = 0 Landau levels remain below the Fermi energy for fields above 7 tesla. The energy bands in graphite can be described by a set of seven parameters (including the Fermi energy as a parameter). In a quantizing magnetic field the Landau levels are described by a secular equation determined by diagonalizing the Hamiltonian. A major feature for the levels along the Brillouin zone edge is that the n = 0 Landau level for electrons is independent of magnetic field, while that for holes is field-dependent. Author

N72-30742*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC FIELD EFFECTS ON SUPERCONDUCTIVITY IN ALKALI METAL INTERCALATES OF MoS2
John A. Woollam, Dennis J. Flood, David E. Wagoner, Robert Somoano (JPL), and Alan Rembaum (JPL) 18 Aug. 1972 10 p refs
(NASA-TM-X-68109) Avail: NTIS HC $3.00 CSCL 20L

The effects of a magnetic field on the superconducting transition in MoS2 intercalated with potassium and sodium were studied. It was found that the potassium intercalated MoS2 has better properties in a magnetic field. In zero magnetic field the transition to superconductivity begins near 6.4 K. Diagrams of the basic circuitry for superconducting transition studies, and charts showing critical magnetic field versus critical temperature for the intercalated MoS2 are included. F.O.S.

N72-30743*# Monsanto Research Corp., St. Louis, Mo.
DEVELOPMENT OF HIGH TEMPERATURE GALLIUM PHOSPHIDE RECTIFIERS
M. G. Craford and D. L. Keune Washington NASA Sep. 1972 57 p refs
(Contract NAS3-14387)
(NASA-CR-2098) Avail: NTIS HC $3.00 CSCL 20L

Large area high performance, GaP rectifiers were fabricated by means of Zn diffusion into vapor phase epitaxial GaP. Devices with an active area of 0.01 sq cm typically exhibit forward voltages of <3 volts for a bias current of 1 ampere and have reverse breakdown voltages of >300 volts for temperatures from 27 C to 400 C. Typical device reverse saturation current at a reverse bias of 150 volts is less than 10 to the minus 9th power amp at 27 C and less than 0.000050 amp at 400 C. Author

N72-30744# Bendix Corp., Kansas City, Mo.
BEAM LEAD SEMICONDUCTOR TESTING AND FAILURE ANALYSIS
L. W. Smith and L. W. Brown Dec. 1971 23 p refs
(Contract AT(29-1)-613)
(BDX-613-614) Avail: NTIS

Testing, handling, and failure analysis processes for beam lead semiconductor devices were investigated. Destructive electrical testing at room temperature and under environmental conditions was demonstrated. Failure analysis included a study of elementary methods for removal of the BLD from substrates, visual inspection, electrical probing, and cross sectioning. Shipment methods are also discussed. F.O.S.

N72-30745# Sandia Labs., Albuquerque, N.Mex.
TECHNIQUE FOR MEASURING THE ADHESION OF THIN FILMS AND THE DYNAMIC TENSILE STRENGTH OF BONDS, WITH COMMERCIAL APPLICATIONS
N. C. Anderholm and A. Goodman Mar. 1972 7 p refs Sponsored by AEC
(SC-DR-69-320) Avail: NTIS

A description is given of how the tensile strength of bonds between two solids and the adhesion of thin films can be dynamically tested by means of the deposition of energy through the use of a pulsed laser or a pulsed electron beam machine. This technique is described, its commercial applicability is discussed, and conclusions are drawn. Author

N72-30746# California Univ., Livermore. Lawrence Livermore Lab.
TIME RESOLVED X-RAY DETECTION USING MOS-C DETECTORS
R. Kalibjian, D. Ciarlo, K. Mayeda, and T. Boster 16 Feb. 1972 7 p refs Presented at Scintillation and Semiconductor Counter Symp., Washington, D. C., 1 Mar. 1972 Sponsored by AEC
(UCRL-73493; Conf-720306-2) Avail: NTIS

To develop a fast X-ray detector with a memory, experiments were performed with metal-oxide-semiconductor capacitor devices. For time-resolved recording the X-ray pulse, a linear array of detectors is uniformly irradiated while the elements are sequentially biased at Delta t time intervals. Significant positive charge trapping occurs in each element of the array only during the period Delta t when the high field bias is applied across the dielectric. Detection of 10-nsec resolution was recorded. Time-resolution is limited by the bandwidth limitation of the bias strobing method. Author (NSA)

N72-30747# Laboratoire Central de Recherches Thomson, Orsay (France).
SECONDARY ELECTRON MICROSCOPE SCANNING OF MATERIAL SAMPLES FOR OPTIMUM USAGE OF THIS DEVICE AND INTERPRETATION OF RESULTS Final Report [ETUDE D'ECHANTILLONS DE DIVERS MATERIAUX AVEC UN MICROSCOPE ELECTRONIQUE SECONDAIRE A BALAYAGE EN VUE DE PRECISER LES NORMES D'UNE UTILISATION OPTIMALE DE CET APPAREIL ET

L'INTERPRETATION DES OBSERVATIONS RAPPORT FINAL]
G. Blet and R. Ansel [1971] 82 p refs In FRENCH
(Contract DGRST-68-01-362-00-212-75-01)
Avail: NTIS HC $6.25

The principle of secondary electron emission is recalled and a description of the scanning electron microscope is given. Variations of the secondary emission coefficient versus parameters such as primary electron energy (2 to 20 keV), primary electron angles of incidence (0 to 80 deg), atomic number of Al-13, Cr-24, Ni-28, Cu-29, Ag-47, Sm-50, Au-79, and Pb-82, were studied and the curves obtained are interpreted. In addition, the alteration of image contrast due to the difference in secondary emission coefficient, which is obtained by twin gold film deposition was studied by varying the deposited layer thickness and the primary electron acceleration tension. ESRO

N72-30748# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DEFORMATION MECHANISMS OF TANTALUM CARBIDE UP TO 2200 C Ph.D. Thesis - Paris Univ. [MECANISMES DE DEFORMATION DU CARBURE DE TANTALE JUSQU'A 2200 C]
Jean-Luc E. Martin 1972 79 p refs In FRENCH; ENGLISH summary
(ONERA-P-143) Avail: NTIS HC $6.00

Thin sheets of tantalum carbide were prepared by a diffusion treatment at 2200 C. Electron diffraction diagrams were observed and revealed an ordering of carbon vacancies in some of the samples. In the face centered cubic phase, dislocation splitting has been evidenced up to TaCo.9. For the carbide TaCo.98 a width of splitting of some ten interatomic distances is very likely though not detectable by electron microscope observations. The mechanical behaviour of the carbide has been studied on a four point bending apparatus. It allows accurate measurement of small loads and deflections up to 2200 C under vacuum. The strain rate law of the carbide has been derived between 900 and 2000 C and for small plastic strains. The activation volume is constant and close to 100 b cubed the activation energy close to 5,8 eV which is the energy of carbon diffusion in the carbide. It seems that in this temperature range a mechanism of viscous glide occurs: the dislocation cores should be almost free from carbon atoms; dislocation loops are then able to glide by a synchroshear mechanism except at certain pinning points which are spurious carbon atoms. The glide velocity is then bound to the stress assisted diffusion of these atoms. Author (ESRO)

N72-30749# Rome Univ. (Italy). Inst. of Physics.
INFLUENCE OF DIMENSIONALITY ON BOSE CONDENSATION AND MACROSCOPIC COHERENCE IN SUPERCONDUCTORS
G. Lucano, S. Pace, and G. L. Romani 23 Mar. 1972 7 p refs Sponsored in part by CNR
(Nota-Interna-365) Avail: NTIS HC $3.00

The influence of dimensionality on Bose condensation and on the appearance of a specific macroscopic effect, the flux quantization, is numerically evaluated, assuming a Bose gas with one or two dimensions smaller than the critical one and solving self-consistent equations containing a couple of temperatures Tc and To (critical temperature and condensation temperature) instead of the usual Tc of a superconductor. ESRO

N72-30750# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
DEGRADATION OF MAGNESIUM FLUORIDE: INFLUENCE OF THE CONDITIONS OF IRRADIATION
M. Romero Jun. 1972 31 p refs
(ONERA-NT/02/30) Avail: NTIS HC $3.75

Magnesium fluoride samples grown by the Czochralski method were irradiated by 1.39 MeV electrons with intensity of 3.6 x 10 to the 11th power e/sq cm/sec. Four stages were observed in the degradation curve n sub F(Dt) (n sub F = local F centers density), stage 1 consisting of fast coloring process associated with impurities, stage 2 ruled by F interstitial recombination apearing only at low dose rates, stage 3 giving a linear relation between n sub f and Dt, stage 4 giving a linear relation between n sub F and (Dt) exp. 1/2. ESRO

N72-30751# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PROCUREMENT OF RELIABLE SEMICONDUCTOR DEVICES FOR MILITARY SPACE APPLICATIONS
Alan G. Stanley 3 Apr. 1972 49 p refs
(Contract F19628-70-C-0230)
(AD-741822; TN-1972-20; ESD-TR-72-81) Avail: NTIS CSCL 09/1

A study was undertaken to determine the feasibility of obtaining high reliability devices for long term space missions and military applications by imposing and monitoring additional process quality controls and screening procedures on standard commercial production lines. A survey of more than a dozen semiconductor manufacturers indicated that the following reliability areas are not adequately controlled: metallization, wire bonding, loose conductive particles and ceramic packages sealed by low melting point glasses. Wide variations were found in the manner in which the bond strength test is carried out. Methods were studied to institute SEM inspection and a more rigorous bond strength test on the production lines, coupled with wafer and bonder traceability. This report surveys reliability problems caused by defects in semiconductor devices and their control.
Author (GRA)

N72-30752# Sperry Rand Research Center, Sudbury, Mass.
NON-LINEAR ELECTROOPTIC Q-SWITCH MATERIAL Semiannual Report, 1 Aug. 1971 - 31 Jan. 1972
Michael Kestigian, Wilfred R. Bekebrede, Bill McCollum, and J. Bruce Thaxter Feb. 1972 32 p refs
(Contract DAAB07-71-C-0336; DA Proj. 1S6-62705-A-056)
(AD-742204; SRRC-CR-72-3; ECOM-0336-1) Avail: NTIS CSCL 20/6

The objective of this exploratory development program is to obtain a new electrooptic material that can be grown relatively easily, is of optical quality, resists damage to high intensity laser radiation, possesses a low half-wave voltage, and is suitable for Q-switching of visible and near infrared radiation at low repetition rates. Towards this objective numerous heretofore unknown complex oxide compounds were prepared in polycrystalline form and characterized. Preliminary X-ray diffraction studies were conducted, and several new tungsten bronze structures were obtained from these new products. The compounds KBa5Nb9ZrO30 and Ba2LaLiNaLi2Nb10O30 were observed to exhibit the tetragonal tungsten bronze structure with a = 12.625; 12.41 and c = 4.010, 3.92 A, respectively. Barium strontium niobate, in which the zirconium cation was isomorphously substituted for a portion of the niobium cation, was also prepared. Author (GRA)

N72-30753# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
THE TEMPERATURE COEFFICIENTS OF ACOUSTIC SURFACE WAVE VELOCITY AND DELAY ON LITHIUM NIOBATE, LITHIUM TANTALATE, QUARTZ, AND TELLURIUM DIOXIDE
Andrew J. Slobodnik, Jr. 22 Dec. 1971 110 p refs
(AF Proj. 5635)
(AD-742287; AFCRL-PSRP-477; AFCRL-72-0082) Avail: NTIS CSCL 09/1

A systematic search for zero temperature coefficient of acoustic surface wave delay has been made on the materials, TeO2, quartz, LiTaO3 and LiNbO3. Such temperature compensated orientations are needed for application to wideband multifunction modems and other signal processing devices. Two temperature compensated cuts of TeO2 were discovered. The lowest temperature coefficient of delay on LiTaO3 was found. The 41.5 degree rotated cut, X-propagating orientation of LiNbO3 has a

temperature coefficient of delay of 72 ppm/C which is the best yet found for this material. Author (GRA)

N72-30754# California Univ., Irvine.
THEORY OF SURFACE MAGNETOPLASMONS IN SEMICONDUCTORS
J. J. Brion, R. F. Wallis, A. Hartstein, and E. Burstein 5 Apr. 1972 11 p refs
(Contract N00014-69-A-0200-9003; NR Proj. 015-731)
(AD-742120; TR-72-20) Avail: NTIS CSCL 20/12

A theory of surface magnetoplasmons in semiconductors is developed with the inclusion of retardation for the geometry in which the magnetic field is parallel to the surface and the direction of propagation is perpendicular to the magnetic field. If the background dielectric constant lies in a suitable range for a given value of the magnetic field, gaps appear in the dispersion relation for the surface magnetoplasmons. The possible experimental observation of these gaps is discussed.
Author (GRA)

N72-30755# Technion Research and Development Foundation, Ltd., Haifa (Israel).
PROPERTIES OF ELECTRON GAS IN CONSTANT MAGNETIC AND ELECTRIC FIELDS Final Technical Report, Dec. 1970 - Nov. 1971
Joshua Zak Dec. 1971 11 p refs
(Contract DAJA37-71-C-1977; DA Proj. 200-61102-B-31-E)
(AD-742242; ARDG(E)-E-1262) Avail: NTIS CSCL 20/12

The dynamics of electrons in semiconductors and metals in constant electric and magnetic fields was investigated. The research has concentrated on two problems: the motion of electrons in a constant electric field in both a finite and infinite range, and the significance of the magnetic symmetry for a Bloch electron in a constant magnetic field. For the finite range electric field problem a number of models were solved. The numerical results in the case of a periodic potential given by a cosine are of particular interest. For this model a detailed dependence of the energy gap on the electric field strength was obtained. The case of an infinite range electric field has been approached on the basis of spectral theory. For the magnetic field an attempt has been made to reconsider the irreducible representations of the magnetic translation group in order to investigate the significance of the magnetic symmetry.
Author (GRA)

N72-30756# Sheffield Univ. (England). Dept. of Physics.
ELECTRONIC STRUCTURE OF METALLIC ALLOYS Final Technical Report, Feb. 1971 - Jan. 1972
N. H. March, J. C. Stoddart, and J. S. Rousseau Mar. 1972 91 p refs
(Contract DAJA37-71-C-2854; DA Proj. 200-61102-B-11B)
(AD-740837; E-1483) Avail: NTIS CSCL 20/12

The two part report discusses: An electron theory treatment of relaxations round the lattice of point defects in metals, and the development of electron states in disordered systems by considering the electrical resistivity of liquid metals where there is strong electron scattering. Some preliminary results are shown but applicability and generalization of this work are only suggested. Author (GRA)

N72-30757# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF CV CHARACTERISTICS TO CONTROLLING MIS PROCESSING M.S. Thesis
Robert A. Fritschie Mar. 1972 79 p refs
(AD-742430; GE/EE/72-12) Avail: NTIS CSCL 09/1

The purpose of this report is to determine the usefulness of the capacitance-voltage (CV) method as a process control tool. To accomplish this task a study of the physics of MIS structures and the theory of the CV method are given. Then it is shown how the method can be used to obtain various physical properties of the semiconductor, insulator, and semiconductor-insulator interface. A computer program which facilitates the determination of various properties from the CV characteristic is included. The substrate material used is n-type silicon and the kinds of insulators investigated in this study are: Si3N4 SiO2, Al2O3 SiO2, and SiO2. Author (GRA)

N72-30758# California Univ., San Diego. Dept. of Physics.
RELATION BETWEEN BULK AND SURFACE PROPERTIES OF MAGNETIC AND SUPER CONDUCTING MATERIALS Final Report, 1 Feb. 1967 - 30 Sep. 1971
Harry Suhl 13 Apr. 1972 12 p refs
(Grant AF-AFOSR0610-67; AF Proj. 9761)
(AD-741891; AFOSR-72-0936TR) Avail: NTIS CSCL 20/12

The topics studied, listed in the order of the intensity of the effort mounted, were; formation and behavior of magnetic moments in metals, dynamic and static characteristics of Type-II superconductors, surfaces physics, and understanding of catalysis by metals as ultimate objective, and general many-body theory, because of its service function in specific applications.
Author (GRA)

N72-30759# Wisconsin Univ., Madison. Dept. of Physics.
EXPERIMENTAL SOLID STATE PHYSICS EMPLOYING MAGNETIC RESONANCE TECHNIQUES Final Report
P. R. Moran 30 Mar. 1972 9 p refs
(Grant AF-AFOSR-1749-69; AF Proj. 9763)
(AD-741910; AFOSR-72-0730TR) Avail: NTIS CSCL 20/12

The report describes research progress, results, and discoveries in studying small concentration defect states and rare event effects in solids by using magnetic resonance and optical properties techniques. Author (GRA)

N72-30760# Stanford Univ., Calif. Center for Materials Research.
NEW SUPERCONDUCTORS Semiannual Technical Report, 1 Aug. 1971 - 31 Jan. 1972
James P. Collman and William A. Little Mar. 1972 122 p refs
(Contract N00014-67-A-0112-0056; ARPA Order 1681)
(AD-740698; CMR-72-4; SATR-3) Avail: NTIS CSCL 07/2

The report covers work on the study of possible high temperature superconductors. It describes theoretical work on filamentary organo-metallic materials - the conduction mechanism, band theory and screening progress towards the synthesis of metallic chain compounds and related organo-metallic complexes, and experimental studies of their solid state properties. The research projects described include the following: Synthesis of a rhodium bis(diacetylmonoximeimino)propane compound; Synthesis of (metal-carbonyl) tin hydrides and (metal-carbonyl) di tin compounds; Synthesis of dodecamethyl cyclohexagermane and synthesis of precursors to tin polymers; Synthesis of Ir(CO)2(acetylacetonate), azulene acetylacetonate, and other iridium carbonyls. GRA

N72-30761# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON STRUCTURE AND PHYSICAL PROPERTIES OF SOME SULFIDES OF D-TRANSITION METALS
V. K. Oganesyan 18 Jan. 1972 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Fiz. (Yerevan, USSR), v. 2, no. 1, 1967 p 55-64
(AD-741498; FTD-MT-24-1383-71) Avail: NTIS CSCL 20/12

The conductivity and thermoelectromotive force of a number of chalcogenide phases of titanium, zirconium, hafnium, and thorium were investigated. From the results, it follows that for the sulfides of titanium the transition from metallic to semiconductor properties is developed at a greater S/metal(Me) ratio than for the sulfides of zirconium, hafnium and thorium.
Author (GRA)

N72-30762# North Carolina Univ., Chapel Hill.
ELECTRONIC STATES IN DISORDERED MATERIALS Semiannual Technical Report, 1 Aug. 1971 - 31 Jan. 1972

M. Silver and K. S. Dy 31 Jan. 1972 16 p refs
(Grant DA-ARO(D)-31-124-71-G52; ARPA Order 1562)
(AD-740168) Avail: NTIS CSCL 20/12

Contents: Mobility of excess electrons in helium gas; Monte Carlo calculations of hot electron currents in dense vapors; Electron drift in gaseous He: density, temperature, and field dependences. GRA

N72-30763# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
LASER PRODUCED DAMAGE IN TRANSPARENT SOLIDS Final Scientific Report, 1 Mar. 1969 - 30 Sep. 1971
David F. Edwards and C. Y. She Feb. 1972 38 p refs
(Contract F19628-69-C-0197; AF Proj. 4645)
(AD-740951; AFCRL-72-0143) Avail: NTIS CSCL 20/12

The mechanism governing the onset of laser-produced damage in solids was found to depend, in a critical way, on the spatial and/or temporal gradient of the interaction strength across the focal or volume. As a result, the threshold values of damage produced by a multimode laser as well as the internal damage patterns depend strongly on the laser propagation and polarization directions. In the forward scattering experiment, the cumulative effects of microscopic damage were observed in crystalline quartz. Other experiments designed to detect cumulative effects were inconclusive. Various light scattering spectroscopy as a diagnostic tool for laser-produced damage studies were investigated. Author (GRA)

N72-30764# Wesleyan Univ., Middletown, Conn. Dept. of Physics.
APPLICATIONS OF THE MOESSBAUER EFFECT TO THE STUDY OF SOLIDS Final Report
William L. Trousdale 8 Mar. 1972 8 p refs
(Grant AF-AFOSR-1634-69; AF Proj. 9763)
(AD-740594; AFOSR-72-0614TR) Avail: NTIS CSCL 20/12

The principal areas of research were in the investigation of magnetic ordering in diluted magnetic materials and an investigation of heat transport in superconductors by the forced motion of normal regions induced by an external magnetic field. Author (GRA)

N72-30765# Radio Corp. of America, Princeton, N.J.
HIGH-BRIGHTNESS ELECTROLUMINESCENT DIODES Annual Report, 1 Jan. - 31 Dec. 1971
Charles J. Nuese, Andrew G. Sigai, and Irwin Kudman Jan. 1972 73 p refs
(Contract N00014-71-C-0198; NR Proj. 215-172)
(AD-740183; PRRL-72-CR-5) Avail: NTIS CSCL 20/12

The purpose of the investigation discussed in this report was to prepare In(1-x)Ga(x)P material from which high-brightness electroluminescent diodes could be made. Throughout the course of the investigation, three growth techniques were used to prepare material for this purpose. The authors examine in detail the energy band structure of In(1-x)Ga(x)P. In the next section, In(1-x)Ga(x)P prepared by a zone-leveling and a traveling-solvent growth technique is considered. The fabrication and characteristics of p-n junctions formed by Zn diffusion into n-type melt-grown In(1-x)Ga(x)P are treated also. The principles of vapor-phase growth, and many refinements in this technology have been carried out. The high-brightness diodes and orange-light-emitting junction lasers mentioned above are described in detail. GRA

N72-30766# California Univ., Los Angeles. Dept. of Physics.
ENERGY TRANSFER Annual Report, 1 Nov. 1970 31 Oct. 1971
Raymond Orbach, Philip Pincus, and T. Holstein 23 Mar. 1972 25 p refs
(Contract N00014-69-A-0200-4032)
(AD-740350) Avail: NTIS CSCL 20/12

The main thrust of the effort over the last year has been in the fields of magnetic resonance of local moments in metals; thermodynamic properties of organic charge transfer salts, and the properties of superfluid helium. In addition, there has been work on superconductivity, electronic structure of transition metals, cooperative Jahn-Teller effect, and Orbach relaxation in insulators. The final section of the report briefly describes future research plans. The principal directions continue to be in the areas of the dynamics of magnetic alloys and the electronic and magnetic properties of molecular charge transfer solids. Author (GRA)

N72-30767# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
RESISTIVITY AND CARRIER LIFETIME IN GOLD-DOPED SILICON Final Report, 10 May - 31 Dec. 1971
W. Robert Thurber and W. Murray Bullis 31 Jan. 1972 38 p refs
(PRO-Y-71-906; AF Proj. 4608)
(AD-740592; AFCRL-72-0076) Avail: NTIS CSCL 20/12

The report describes the present status of an on-going study of the properties of gold-doped silicon. Resistivity, Hall effect, and carrier lifetime are being measured at room temperature in silicon wafers doped with varying amounts of gold and either phosphorus or boron. Reasons are being sought for the apparent discrepancy between total and electrically active gold, for the discrepancy between calculated and observed resistivity in both n-type and p-type specimens with very large gold concentration, and for the diversity in capture cross section data reported in the literature. Initial studies of the application of the surface photovoltage method to the measurement of carrier lifetime in gold-doped silicon have been completed. This method also appears to be suitable for use on gallium arsenide specimens. A bibliography of the literature on properties of gold-doped silicon that contains 136 entries is also included as an appendix. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-30768*# Scientific Translation Service, Santa Barbara, Calif.
BURNUP DETERMINATION OF FUEL THROUGH FLUENCE MONITORING WITH COBALT
E. Munch Washington NASA Aug. 1972 6 p refs Transl. into ENGLISH from Atomwirtschaft (Duesseldorf), v. 16, no. 10, Oct. 1971 p 530-531
(Contract NASw-2035)
(NASA-TT-F-14527) Avail: NTIS HC $3.00 CSCL 21B

The status of fuel consumption can be determined nondestructively 3 days after the end of irradiation with a short measuring time by mixing 5% Co-59 into the fuel at 1.173 and 1.333 MeV. Author

N72-30769# National Aviation Facilities Experimental Center, Atlantic City, N.J.
PERFORMANCE OF A DC-9 AIRCRAFT LIQUID NITROGEN FUEL TANK INERTING SYSTEM Final Report, Apr. 1971 - Mar. 1972
E. P. Klueg, W. C. McAdoo, and W. F. Neese May 1972 75 p refs
(FAA Proj. 184-733-01X)
(FAA-RD-72-53; FAA-NA-72-38) Avail: NTIS HC $5.75

Nitrogen inerting protection for the fuel systems in commercial aircraft has been proposed to reduce fire and explosion hazards associated with refueling, electrical and mechanical failures, engine failures, in-flight fires, lightning strikes, and survivable crashes. A liquid nitrogen fuel tank

inerting system was developed and installed on a DC-9 aircraft. Instrumentation equipment and measurement techniques for evaluating the installed fuel tank inerting system performance were developed. A flight test program was conducted to demonstrate compliance of the DC-9 inerting system with applicable airworthiness standards, to evaluate oxygen concentration measurement techniques, and to verify that the installed inerting system maintained an explosion safe mixture in the fuel tanks over the entire flight envelope. Oxygen concentrations at various locations of the ullage and vent systems and the operating characteristics of the inerting system were determined during the flight test program. The inerting system was determined to be capable of maintaining a mixture in the fuel system vents and tank vapor spaces having a volumetric oxygen concentration less than 8 percent under all normal and emergency flight conditions. Author

N72-30770# Explosives Research and Development Establishment, Waltham Abbey (England).
COMPATIBILITY AND STABILITY TESTING OF EXPLOSIVES AND SOLID PROPELLANTS
N. J. Blay and I. Dunstan Nov. 1970 28 p Presented at the Symp. on Res. on Mil. Explosives and Ammunition, Neth., 26 Sep. 1969
(ERDE-TR-45; BR23438) Avail: NTIS HC $3.50

A general account of the main principles involved in the compatibility and stability testing of explosives, pyrotechnics, and solid propellants, including composite and colloidal propellants is given. Emphasis is given to laboratory methods of assessment based on observation of chemical change occurring under accelerated aging conditions, but mention is also made of physical factors such as exudation and migration of ingredients, and the effect of explosives and propellants on the mechanical properties of polymers, rubbers, and other structural materials.
Author (ESRO)

N72-30771# IIT Research Inst., Chicago, Ill. Engineering Mechanics Div.
INITIATION MECHANISMS OF SOLID ROCKET PROPELLANT DETONATION Final Scientific Report, 1 Apr. 1967 - 31 Mar. 1971
Hyla S. Napadensky and Christian A. Kot Nov. 1971 34 p refs
(Contract F44620-67-C-0081; AF Proj. 9711)
(AD-741901; AFOSR-71-3028TR) Avail: NTIS CSCL 21/9

An experimental and analytical investigation was conducted to study the physical and chemical processes governing the ignition and release of energy under low amplitude, accidently applied stimuli. To determine the mechanisms responsible for initiation of detonation in low-speed impact a two-dimensional tensor code has been developed. The code is applied to calculations of the mechanical response of solid composite and double base propellant materials in unconfined impact against a rigid surface. Computations were also carried out for TNT. Estimates were made of the transient temperature field in these materials resulting from the dissipation of the mechanical energy of impact. Impact experiments on solid propellants and on inert simulants were also carried out. Author (GRA)

N72-30868* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRUCTURAL DAMAGE CLAIMS RESULTING FROM ACOUSTIC ENVIRONMENTS DEVELOPED DURING STATIC TEST FIRING OF ROCKET ENGINES
Stanley H. Guest and Robert M. Slone, Jr. *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 45-69 (For availability see N72-30865 21-31)
CSCL 21H

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research sec: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N72-30772*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STABILITY EVALUATION OF A ROCKET ENGINE FOR GASEOUS OXYGEN DIFLUORIDE (OF2) AND GASEOUS DIBORANE (B2H6) PROPELLANTS
Richard M. Clayton 15 Aug. 1972 40 p refs
(Contract NAS7-100)
(NASA-CR-127859; JPL-TR-32-1561) Avail: NTIS HC $4.00 CSCL 21H

Results of an experimental evaluation of the dynamic stability of a candidate combustor for the space storable propellants gaseous OF2/B2H6 show that the combustor is unstable without supplementary damping. A computer analysis indicated that the uninhibited engine could be unstable. The experiments, conducted with O2/C2H4 substitute propellants and with 70-30 FLOX/B2H6 (OF2 simulated with FLOX), show that the uninhibited combustor has a low stability margin to starting transient perturbations, but that is relatively insensitive to bomb disturbances. Damping cavities are shown to provide stability. Author

N72-30773*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WALL TEMPERATURE DISTRIBUTION CALCULATION FOR A ROCKET NOZZLE CONTOUR
Satoaki Omori (NAS-NRC), Klaus W. Gross, and Alfred Krebsbach Washington Jul. 1972 115 p refs
(NASA-TN-D-6825) Avail: NTIS HC $3.00 CSCL 21H

The JANNAF turbulent boundary layer (TBL) computer program, applicable to rocket nozzles, requires a wall temperature distribution among other input parameters to determine boundary layer behavior, heat transfer, and performance degradation. The inclusion of a complete regenerative cooling cycle model with associate geometry, material and fluid property data provides a capability to internally calculate wall temperature profiles on the hot gas and coolant flow-side, as well as the coolant flow bulk temperature variation. Besides the regular heat transfer and performance degradation calculations, the new concept can be used to optimize the cooling cycle, flow requirements, and cooling jacket geometry. Author

N72-30774*# Pratt and Whitney Aircraft, East Hartford, Conn.
HIGH-LOADING, 1800 FT/SEC TIP SPEED TRANSONIC COMPRESSOR FAN STAGE. 1: AERODYNAMIC AND MECHANICAL DESIGN
A. L. Morris, J. E. Halle, and E. Kennedy Sep. 1972 115 p refs
(Contract NAS3-13493)
(NASA-CR-120907; PWA-4534) Avail: NTIS HC $7.75 CSCL 21E

A single stage fan with a tip speed of 1800 ft/sec (548.6 m/sec) and hub/tip ratio of 0.5 was designed to produce a pressure ratio of 2.285:1 with an adiabatic efficiency of 84.0%. The design flow per inlet annulus area is 38.7 lbm/sq ft-sec (188.9KG/sqm-sec). Rotor blades have modified multiple-circular-arc and precompression airfoil sections. The stator vanes have multiple-circular-arc airfoil sections. Author

N72-30775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA QUIET ENGINES

Carl C. Ciepluch [1972] 18 p refs Presented at INTER-NOISE 72, Washington, D. C., 4-6 Oct. 1972; sponsored by Inst. of Noise Control Eng.
(NASA-TM-X-68121; E-7086) Avail: NTIS HC $3.00 CSCL 21A

Efforts to develop an engine noise reduction technology suitable for use on subsonic and conventional takeoff and landing type aircraft are reported. Two baseline quiet engines were developed and tested. The engines were designed with the following quiet features: (1) high bypass ratio engine, (2) large rotor-stator spacing of rotor chords, (3) reduced rotor tip speeds, (4) sound absorbing liners in inlet-outlet ducts, and (5) an optimum ratio from stator to rotor blades. Test results show that if these features are applied to future aircraft, substantial reduction in aircraft noise levels will be obtained. E.H.W.

N72-30776*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON-THE-SHAFT DATA SYSTEMS FOR ROTATING ENGINE COMPONENTS
Daniel J. Lesco, John C. Sturman, and William C. Nieberding 1972 23 p ref Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972
(NASA-TM-X-68112; E-7053) Avail: NTIS HC $3.25 CSCL 21A

Two rotating data systems for engine component testing which demonstrate the techniques of on-the-shaft microelectronic signal conditioning and rotary transformer power- and data-transfer are described. (1) A digital data system provides 69 channels of 1100 C maximum thermocouple data with less than 0.5 percent error from a turbine test rig rotating at speeds up to 9000 rpm. (2) An analog data system amplifies and transfers 72 channels of dynamic strain data with less than 5 percent error from a compressor rig at speeds above 14,000 rpm. Author

N72-30777*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEA-LEVEL EVALUATION OF DIGITALLY IMPLEMENTED TURBOJET ENGINE CONTROL FUNCTIONS
Dale J. Arpasi, David S. Cwynar, and Robert E. Wallhagen Washington Sep. 1972 28 p refs
(NASA-TN-D-6936; E-6977) Avail: NTIS HC $3.00 CSCL 21E

The standard hydromechanical control system of a turbojet engine was replaced with a digital control system that implemented the same control laws. A detailed discussion of the digital control system in use with the engine is presented. The engine was operated in a sea-level test stand. The effects of control update interval are defined, and a method for extending this interval by using digital compensation is discussed. Author

N72-30778*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROPULSION TECHNOLOGY FOR AN ADVANCED SUBSONIC TRANSPORT
Milton A. Beheim, Robert J. Antl, and John H. Povolny Washington Sep. 1972 20 p refs
(NASA-TM-X-2625; E-6913) Avail: NTIS HC $3.00 CSCL 21A

Engine design studies for future subsonic commercial transport aircraft were conducted in parallel with airframe studies. These studies surveyed a broad distribution of design variables, including aircraft configuration, payload, range, and speed, with particular emphasis on reducing noise and exhaust emissions without severe economic and performance penalties. The results indicated that an engine for an advanced transport would be similar to the currently emerging turbofan engines. Application of current technology in the areas of noise suppression and combustors imposed severe performance and economic penalties. Author

N72-30779# Joint Publications Research Service, Arlington, Va.
AVIATION GAS-TURBINE ENGINES IN POWER ENGINEERING
S. N. Uvarov 24 Jul. 1972 28 p Transl. into ENGLISH from the Publ. "Aviatsionnye Gazoturbinnyye Dvigateli v Energetike" Leningrad, Energiya, 23 Jul. 1971 p 5-25
(JPRS-56581) Avail: NTIS HC $3.50

A basic design description is presented for gas turbine engines and gas turbogenerators. Their specifications and use in aircraft are also discussed. Author

N72-30780# Committee on Public Works (U. S. Senate).
ALTERNATIVES TO THE GASOLINE-POWERED INTERNAL COMBUSTION ENGINE
Washington GPO 1972 135 p Hearing before Comm. on Public Works, 92d Congr., 2d Sess., 14 Mar. 1972
Avail: Panel on Envoron, Sci. and Tech. of the Subcomm. on Air and Water Pollution

A Congressional hearing on the subject of alternatives to the gasoline powered internal combustion engine in order to reduce air pollution is presented. Research projects and engineering developments for electric engines, Diesel engines, and steam engines are discussed. The report is composed primarily of testimony of experts in the field of propulsion systems for ground vehicles. P.N.F.

N72-30781# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
A STUDY OF THRUST-MODULATION TECHNIQUES
R. L. Davey and C. White Paris ESRO Jul. 1971 208 p refs
(Contract ESTEC-880/69)
(ESRO-CR-49) Avail: NTIS HC $12.50

Methods of modulating the thrust of gas jets for satellite attitude control are examined and assessed, and some general aspects of gas-jet control, including optimum acquisition, limit-cycle control and pseudo-linear operation, are discussed. Design procedures for derived-rate, pulse-ratio and integral-pulse-fregeuncy modulators are given. A new modulator, known as the adjacent-pulse modulator, is presented. This has certain advantages for missions having high accuracy requirements and low disturbance torques. The effect of sensor and thruster noise on modulator performance is considered, and implementation aspects are covered. The modulators are compared and their application to four typical missions is assessed; it is shown that the derived-rate and pulse-ratio modulators are generally most useful. Author (ESRO)

N72-30782# Purdue Univ., Lafayette, Ind.
PROJECT SQUID Semiannal Progress Report, 1 Oct. 1971 - 30 Oct. 1972
T. Adamson, F. Carta, P. Chung, J. Daiber, and R. Dobbins 1 Apr. 1972 127 p refs
(Contract N00014-67-A-0226-0005; NR Proj. 008-038)
(AD-742350) Avail: NTIS CSCL 21/5

Reports of progress during the past six months on the 18 research programs comprising Project SQUID are presented. The research programs fall into the areas of Fluid Mechanics, Atomic and Molecular Collisions, Measurement Techniques, and Combustion and Chemical Rate Processes. Project SQUID is a cooperative program of basic research related to jet propulsion. It is administered by Purdue University and sponsored by the Office of Naval Research. Author (GRA)

N72-30783# Naval Air Propulsion Test Center, Trenton, N.J. Aeronautical Turbine Dept.
DERIVATION AND EVALUATION OF A RADIAL INLET PRESSURE DISTORTION INDEX Final Technical Report
Donald F. Brunda and Joseph F. Boytos Apr. 1972 48 p refs
(AD-742446; NAPTC-ATD-216) Avail: NTIS CSCL 21/5

A generalized, steady-state, radial inlet pressure distortion index (Kr) was derived theoretically, and evaluated by full-scale tests on a J52-P-8A turbojet engine. Test data at stall for one-per-span hub-radial and tip-radial distortion was generalized with the derived distortion index Kr as a function of low compressor rotor speed and corrected average radius ratio. At

each corrected rotor speed, the Kr defines the distortion tolerance of the compressor, regardless of the radial position, or extent, of the distortion. Author (GRA)

N72-30784# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
RESEARCH ON THE FLUTTER OF AXIAL-TURBOMACHINE BLADING
Fernando Sisto and Ron Ho Ni May 1972 42 p refs
(Contract N00014-67-A-0202-0016; NR Proj. 094-363)
(AD-742458; ME-RT-72005) Avail: NTIS CSCL 10/1

Theoretical and experimental phases of a program to study flutter in turbomachinery blading are summarized. A general analytical method for predicting the aerodynamic characteristics of partly stalled airfoil is introduced and it agrees with experimental results. The effect of location of rotation axis on quasistatic aerodynamic moment is displayed and generalized conclusions are drawn. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation, and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N72-30785*# Stanford Univ., Calif.
MECHANICAL-WAVE DISSIPATION IN THE LOWER CORONA: EMPIRICAL REQUIREMENTS FOR QUIET REGIONS
R. L. Moore Jun. 1972 10 p refs
(Grant NGL-05-020-272)
(NASA-CR-127345; SU-IPR-476) Avail: NTIS HC $3.00 CSCL 03B

The relation between dissipation and temperature structure in the lower corona was empirically determined. This relation was then used in conjunction with the observed structure to estimate the damping length for mechanical waves. Author

N72-30786*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MODULATION OF LOW ENERGY GALACTIC COSMIC RAYS OVER SOLAR MAXIMUM (CYCLE 20)
M. A. I. VanHollebeke, J. R. Wang, and F. B. McDonald Aug. 1972 14 p refs Submitted for publication
(NASA-TM-X-65989; X-660-72-292) Avail: NTIS HC $3.00 CSCL 03B

A preliminary report is presented on detailed observations of low energy approximately (60 MeV/nucleon) galactic cosmic rays made during the recent period of solar maximum. For this particular cycle a significant time lag between intensity changes in the low energy and high energy components was observed. There are a number of possible explanations of this hysteresis effect. In the simplest form these include either changes in the form of the magnetic field power spectrum or changes in the size of the effective modulating region, or both. Author

N72-30787*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ACCELERATION OF HIGH-ENERGY PARTICLES IN SOLAR FLARES
Kunitomo Sakurai (Md. Univ.) Aug. 1972 19 p refs
(NASA-TM-X-65992; X-693-72-264) Avail: NTIS HC $3.00 CSCL 03B

The relationship is discussed between some characteristics of microwave Type 4 radio bursts and solar cosmic ray protons of MeV energy. It is shown that the peak flux intensity of those bursts is almost linearly correlated with MeV proton peak flux observed by satellites near the earth and that protons and electrons would be accelerated simultaneously by a similar mechanism during the explosive phase of solar flares. Brief discussion is given on the propagation of solar cosmic rays in the solar envelope after ejection from the flare regions. Author

N72-30788*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RECURRENT ACTIVE REGIONS RELATED TO METRIC RADIO CONTINUUM EMISSIONS AND THE INTERPLANETARY MAGNETIC SECTOR STRUCTURE
Kunitomo Sakurai Sep. 1972 16 p refs
(NASA-TM-X-65999; X-693-72-294) Avail: NTIS HC $3.00 CSCL 03B

Active heliographic longitudes at the sun are investigated by using the observational data for long-lived metric continuum noise sources. It is shown that, for the period from 1963 to 1969, the number of such longitudes was four in general and these longitudes were very stable for this radio activity since 1963. A discussion is given on the relationship between those longitudes and the sector structure of the interplanetary magnetic field. Author

N72-30789# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
APPLICATION OF THE GRADIENT METHOD TO A STUDY OF THE SIGNAL/NOISE RATIO OUTPUT OF FILTERS USED IN GAMMA RAY SPECTROMETRY WITH SEMICONDUCTORS
Guy Chazal, Odette Hoclet, Joseph Kermorgant, Claude Ringeard, and Georges Voiculescu Jan. 1972 95 p In FRENCH; ENGLISH summary
(CEA-R-4290) Avail: AEC Depository Libraries

The gradient method was applied to the investigation of the noise/signal ratio at the output of two types of filters used in gamma-spectrometry with a semiconductor detector. This enables a program to be written, in FORTRAN IV, for calculation of the minimum of a function involving 1 to 10 minimization parameters. There is provision for two methods of determining definite integrals in order to permit calculation of the minimum of a function involving a number of integrals. Author (NSA)

N72-30790# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
THE PROPAGATION OF ALFVEN WAVES AND THEIR DIRECTIONAL ANISOTROPY IN THE SOLAR WIND
Heinrich J. Voelk and Werner Alpers Mar. 1972 33 p refs
(MPI-PAE/Extraterr-61) Avail: NTIS HC $3.75

The propagation of solar Alfven waves in interplanetary space is studied in the approximation of geometrical optics. Ray paths and the change of wave vectors and amplitudes along the rays are determined. In particular, the Alfvenic fluctuations in the two directions perpendicular to the magnetic field direction are calculated under the assumption that the Alfven waves are produced at the sun and emitted with an isotropic directional distribution from a reference level close to the sun. Due to the combined effect of spherical expansion of the solar wind flow and the spiralling of the interplanetary field the magnetic fluctuations in the direction perpendicular both to the unperturbed field and the radial direction have much more power than in the other directions (directional anisotropy). Author (ESRO)

N72-30791# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
OBSERVATION OF THE DIFFUSE COSMIC GAMMA RADIATION IN THE 30-50 MeV REGION
H. A. Mayer-Hasselwander, E. Pfeffermann, K. Pinkav, H. Rothermel, and M. Sommer Mar. 1972 17 p refs
(MPI-PAE/Extraterr-64) Avail: NTIS $3.00

Results of two balloon flights are presented in which a gamma ray astronomy spark chamber was carried to residual atmospheric pressures of 1.7 and 2.2 g/sq.m, respectively. A diffuse flux of celestial gamma rays was discovered at 30 to

50 MeV which showed no significant correlation to galactic features and which exceeded a linear interpolation between previously known gamma ray data at 1 and 100 MeV by a factor of between 4 and 10. ESRO

N72-30792# Air Force Weapons Lab., Kirtland AFB, N.Mex.
OV1-19 ISODOSE CONTOURS AT VARIOUS ALTITUDES Interim Technical Report, Mar. 1969 - Aug. 1971
John T. Cervini Feb. 1972 41 p refs
(AF Proj. 8809)
(AD-742226; AFWL-TR-71-164) Avail: NTIS CSCL 04/1

Data collected from the OV1-19 satellite have been reduced, merged, and analyzed to provide dose rates measured by three tissue-equivalent ionization chambers (TEICs) behind various shielding materials. The shields consist of 0.26 grams per square centimeter of shonka plastic, 5.0 grams per square centimeter of lucite, and 12.0 grams per square centimeter of tungsten. Isodose contours as a function of geodetic latitude and longitude have been plotted for altitudes of 270, 510, 1000, 2000, and 3000 NM. These contours were obtained from data collected for 97 revolutions of the satellite over an 11-month lifetime. A time history for all three TEICs is plotted for one specific revolution of data, showing typical sensor behavior for a 4-hour period as the satellite passes through the Van Allen belts. A summary of the effects of solar flare radiation is also presented. Author (GRA)

N72-30793# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SOLAR RADIATION PRESSURE ON HIGH ALTITUDE SATELLITE
Moshe Carmeli Feb. 1972 16 p refs
(AF Proj. 7114)
(AD-741905; ARL-72-0034) Avail: NTIS CSCL 22/3

In the report an exact expression to the solar radiation pressure on a prolate spheroid is given. Author (GRA)

N72-30794# Chicago Univ., Ill. Dept. of Astronomy and Astrophysics.
INVESTIGATIONS OF THEORETICAL PROBLEMS IN COSMICAL GAS DYNAMICS Final Report, 1 Oct. 1965 - 31 Dec. 1970
Peter O. Vandervoort 10 Feb. 1971 12 p refs
(Grant Nonr(G)-00005-66; NR Proj. 046-794)
(AD-740770) Avail: NTIS CSCL 03/3

This is the final report on investigations of theoretical problems in cosmical gas dynamics. An attempt has been made to derive a kinematical model of the Orion Nebula from observational models of the density distribution and data on the internal kinematics. Numerical methods have been developed for integrating the equations governing the dynamics of H II regions by the method of characteristics. Author (GRA)

N72-30795# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
MAGNETIC FIELDS IN SOLAR PROMINENCES: A REVIEW
David M. Rust 12 Jan. 1972 30 p refs
(AF Proj. 7649)
(AD-740580; AFCRL-72-0048; AFCRL-AFSIG-237) Avail: NTIS CSCL 03/2

The development and regular use of magnetographs designed especially for observations of magnetic fields in prominences has sparked new theoretical interest in the structure of these solar objects. Several interesting new models for active prominence field structure have been proposed recently. Most of these models envision force-free magnetic fields in the prominences, and there is some evidence for helical magnetic fields in eruptive prominences. Helical structure is a characteristic of many force-free field models. However, Rust and Roy (1971) have had some success in fitting current-free fields to loop prominences, which are frequently observed in the hours immediately following a major flare. The implications of these observations are discussed. Author (GRA)

N72-30796# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
MAGNETIC FIELDS AND PROTON FLARES, 7 JULY AND 2 SEPTEMBER 1966
A. M. Zvereva and A. B. Severnyi 13 Dec. 1971 77 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Krymakaya Astrofizicheskaya Observ. (USSR), V. 41/42, 1970 p 97-157
(AD-740575; AFCRL-71-0605; AFCRL-Trans-95) Avail: NTIS CSCL 03/2

Contents: Comparison of simultaneous field recordings in the very same line with two photometers; Data of observations, magnetic field maps, general character of magnetic configurations; Variation of the longitudinal and transversal fields (gradients, fluxes, field energy); Position of flares relative to the longitudinal and transversal magnetic fields; Proton flares and total field strength; Proton flares and electric currents--Ampere force and radiation velocities. GRA

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N72-30797*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT SYSTEMS SAFETY. VOLUME 1: EXECUTIVE SUMMARY
23 Jun. 1972 26 p
(Contract NAS8-27692)
(NASA-CR-123764; SD-72-SA-0054-1-Vol-1) Avail: NTIS HC $3.50 CSCL 22A

Safety problems connected with in-space propellant logistics operations are considered. Safety considerations resulting from the system safety analysis in the trade studies and evaluations of alternate operating concepts in the systems operations analysis are presented. Author

N72-30798*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT SYSTEMS SAFETY. VOLUME 2: SYSTEM SAFETY GUIDELINES AND REQUIREMENTS
23 Jun. 1972 86 p
(Contract NAS8-27692)
(NASA-CR-123766; SD-72-SA-0054-2-Vol-2) Avail: NTIS HC $6.50 CSCL 22A

Detailed system safety guidelines/requirements were developed. Each one describes a safety measure which is suggested as a means of eliminating or reducing a particular hazard, or group of hazards, to an acceptable level, and which, if followed would tend to increase the level of safety in supplying propellants to a user in orbit. The first goal was to identify those actions that should be taken to make propellant logistics operations as safe as possible. The second was to serve as a checklist to verify that these actions had been taken in the design and operation of this and similar programs, or that they had been considered and rejected. The safety measures described in the GLR's are directed toward the prevention of hazards, the avoidance of undesired events, and the protection of the crew. Author

N72-30799*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT SYSTEMS SAFETY. VOLUME 3: SYSTEM SAFETY ANALYSIS
23 Jun. 1972 558 p refs
(Contract NAS8-27692)
(NASA-CR-123769; SD-72-SA-0054-3-Vol-3) Avail: NTIS HC $30.00 CSCL 22A

The primary objective was to examine from a system safety viewpoint in-space propellant logistic elements and operations to define the potential hazards and to recommend means to reduce, eliminate or control them. A secondary objective was to conduct trade studies of specific systems or operations to determine the safest of alternate approaches. Author

N72-30800*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT LOGISTICS. VOLUME 1: EXECUTIVE SUMMARY Final Report, 25 Jun. 1971 - 23 Jun. 1972
23 Jun. 1972 33 p refs
(Contract NAS8-27692)
(NASA-CR-123784; SD-72-SA-0053-1-Vol-1) Avail: NTIS HC $3.75 CSCL 22A

The study addresses the systems and operational problems associated with the transport, transfer, and storage of cryogenic propellants in low earth orbits. The safety problems connected with in-space propellant logistics operations are also considered. Correlation between the two projects was maintained by including safety considerations, resulting from the system safety analysis, in the trade studies and evaluations of alternate operating concepts in the systems operations analysis. Author

N72-30801*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT LOGISTICS. VOLUME 2: TECHNICAL REPORT
23 Jun. 1972 438 p refs
(Contract NAS8-27692)
(NASA-CR-123767; SD-72-SA-0053-2-Vol-2) Avail: NTIS HC $24.00 CSCL 22A

For abstract see N72-30800

N72-30802*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT LOGISTICS. VOLUME 3: TRADE STUDIES
23 Jun. 1972 240 p refs
(Contract NAS8-27692)
(NASA-CR-123749; SD-72-SA-0053-3-Vol-3) Avail: NTIS HC $14.00 CSCL 22A

For abstract, see N72-30800

N72-30803*# North American Rockwell Corp., Downey, Calif. Space Div.
IN-SPACE PROPELLANT LOGISTICS. VOLUME 4: PROJECT PLANNING DATA
23 Jun. 1972 101 p refs
(Contract NAS8-27692)
(NASA-CR-123768; SD-72-SA-0053-4-Vol-4) Avail: NTIS HC $7.25 CSCL 22A

The prephase A conceptual project planning data as it pertains to the development of the selected logistics module configuration transported into earth orbit by the space shuttle orbiter. The data represents the test, implementation, and supporting research and technology requirements for attaining the propellant transfer operational capability for early 1985. The plan is based on a propellant module designed to support the space-based tug with cryogenic oxygen-hydrogen propellants. A logical sequence of activities that is required to define, design, develop, fabricate, test, launch, and flight test the propellant logistics module is described. Included are the facility and ground support equipment requirements. The schedule of activities are based on the evolution and relationship between the R and T, the development issues, and the resultant test program.
Author

N72-30804*# North American Rockwell Corp., Downey, Calif. Space Div.
SAFETY IN EARTH ORBIT STUDY. VOLUME 1: TECHNICAL SUMMARY Final Report
12 Jul. 1972 184 p refs
(Contract NAS9-12004)
(NASA-CR-128507; SD-72-SA-0094-1-Vol-1; MSC-04477-Vol-1) Avail: NTIS HC $11.25 CSCL 22A

A summary of the technical results and conclusions is presented of the hazards analyses of earth orbital operations in conjunction with the space shuttle program. The space shuttle orbiter and a variety of manned and unmanned payloads delivered to orbit by the shuttle are considered. The specific safety areas examined are hazardous payloads, docking, on-orbit survivability, tumbling spacecraft, and escape and rescue. N.E.N.

N72-30805*# North American Rockwell Corp., Downey, Calif. Space Div.
SAFETY IN EARTH ORBIT STUDY. VOLUME 2: ANALYSIS OF HAZARDOUS PAYLOADS, DOCKING, ON-BOARD SURVIVABILITY Final Report
12 Jul. 1972 376 p refs
(Contract NAS9-12004)
(NASA-CR-128508; MSC-04477-Vol-2; SD-72-SA-0094-2-Vol-2) Avail: NTIS HC $21.00 CSCL 22A

Detailed and supporting analyses are presented of the hazardous payloads, docking, and on-board survivability aspects connected with earth orbital operations of the space shuttle program. The hazards resulting from delivery, deployment, and retrieval of hazardous payloads, and from handling and transport of cargo between orbiter, sortie modules, and space station are identified and analyzed. The safety aspects of shuttle orbiter to modular space station docking includes docking for assembly of space station, normal resupply docking, and emergency docking. Personnel traffic patterns, escape routes, and on-board survivability are analyzed for orbiter with crew and passenger, sortie modules, and modular space station, under normal, emergency, and EVA and IVA operations. N.E.N.

N72-30806*# North American Rockwell Corp., Downey, Calif. Space Div.
SAFETY IN EARTH ORBIT STUDY. VOLUME 3: ANALYSIS OF TUMBLING SPACECRAFT, ESCAPE AND RESCUE Final Report
12 Jul. 1972 209 p refs
(Contract NAS9-12004)
(NASA-CR-128509; MSC-04477-Vol-3; SD-72-SA-0094-3-Vol-3) Avail: NTIS HC $15.50 CSCL 22A

Detailed and supporting analyses of the hazards of a disabled spacecraft in a tumbling mode and of crew escape, rescue, and survivability are presented for earth orbital operations of the space shuttle program. Tumbling conditions, arresting tumbling by external means, and escape from a tumbling vehicle are discussed. Details on design concepts for the modular space station, integral tank orbiter, drop tank orbiter, and a small space vehicle are included. Results of the crew safety study indicate that the shuttle orbiter should be the primary vehicle for dealing with emergencies and one vehicle should be available for rapid emergency rescue. An Apollo command module should be carried in the orbiter cargo bay in case an orbiter is not available. Approaches for a quicker escape or rescue capability are also recommended. N.E.N.

N72-30807*# North American Rockwell Corp., Downey, Calif. Space Div.
SAFETY IN EARTH ORBIT STUDY. VOLUME 4: SPACE SHUTTLE ORBITER: SAFETY REQUIREMENTS AND GUIDELINES ON-ORBIT PHASE Final Report
12 Jul. 1972 44 p
(Contract NAS9-12004)
(NASA-CR-128510; SD-72-SA-0094-4-Vol-4; MSC-04477-Vol-4) Avail: NTIS HC $4.25 CSCL 22A

Safety requirements and guidelines are listed for the space shuttle orbiter and for its interface with other vehicles. The requirements and guidelines are specific to the hazards and emergencies in earth orbit. The requirements and guidelines for

the orbiter are those with respect to vehicle design, safety devices, warning devices, operational procedures, and residual hazards. The requirements and guidelines for interface with the space station, upper stage vehicles, and sortie payloads are imposed on these vehicles to ensure the safety of the shuttle orbiter. The rationale for the safety requirements and guidelines is also discussed. N.E.N.

N72-30808*# North American Rockwell Corp., Downey, Calif. Space Div.
SAFETY IN EARTH ORBIT STUDY. VOLUME 5: SPACE SHUTTLE PAYLOADS: SAFETY REQUIREMENTS AND GUIDELINES ON-ORBIT PHASE Final Report
12 Jul. 1972 58 p
(Contract NAS9-12004)
(NASA-CR-128511; SD-72-SA-0094-5-Vol-5; MSC-04477-Vol-5) Avail: NTIS HC $5.00 CSCL 22A

Safety requirements and guidelines are listed for the sortie module, upper stage vehicle, and space station for the earth orbit operations of the space shuttle program. The requirements and guidelines are for vehicle design, safety devices, warning devices, operational procedures, and residual hazards. N.E.N.

N72-30809*# TRW Systems Group, Houston, Tex. Mission Design Section.
RESULTS OF THE ESP SCHEDULING EFFORT FOR THE SKYLAB 1/2 EXPERIMENTS AND OPERATIONS
Fred W. Knopf 1 May 1970 186 p
(NASA-CR-128022; TRW-5521.6-31) Avail: NTIS HC $11.50 CSCL 22C

The development of the Skylab crew activities schedule is discussed. The results are presented for the experiment and operations scheduling procedure evaluation. Author

N72-30810*# California Univ., Los Angeles. Space Sciences Center.
MAGNETOMETER INSTRUMENT TEAM STUDIES FOR THE DEFINITION PHASE OF THE OUTER PLANETS GRAND TOUR Status Report
Paul J. Coleman, Jr. 15 May 1972 64 p refs
(Grant NGR-05-007-327)
(NASA-CR-127833) Avail: NTIS HC $5.25 CSCL 22C

The objectives of magnetic field investigations on missions to the outer planets were defined as well as an instrumentation system, a program of studies and instrument development tasks was proposed for the mission definition phase of the Outer Planets Grand Tour project. A report on the status of this program is given. Requirements were also established for the spacecraft and the mission which would insure their compatibility with the magnetic field investigation proposed for the outer planets missions and developed figures of merit for encounter trajectories. The spacecraft-instrumentation interface and the on-board data handling system were defined in various reports by the Project Team and in the reports by the Science Steering Group. The defining program for exploring the outer planets within the more restrictive constraints of the Mariner Jupiter-Saturn project included defining a limited magnetic field investigation. Author

N72-30811*# Pennsylvania State Univ., University Park.
INVESTIGATION OF TECHNICAL PROBLEMS RELATED TO DEPLOYMENT AND RETRIEVAL OF SPINNING SATELLITES Semiannual Progress Report
Marshall H. Kaplan Jul. 1972 48 p refs
(Grant NGR-39-009-162)
(NASA-CR-127866; SAPR-5) Avail: NTIS HC $4.50 CSCL 22A

Quantitative analyses were developed to the point where numerical results can be easily obtained in the optimal transfer trajectory problem. Analyses of deployment dynamics and control of the pairedsatellite concept are progressing. Automatic control in space, optimal retrieval transfer trajectories, deployment attitude dynamics and control, and automatic control systems for retrieval are also considered. Author

N72-30812*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF TRACKING STATION COORDINATE UNCERTAINTIES ON GEOS-2 ORBITAL ACCURACY
Joel Glazer (Computer Sci. Corp.) and W. D. Kahn Aug. 1972 55 p refs
(NASA-TM-X-65998; X-550-72-228) Avail: NTIS HC $4.75 CSCL 22C

Laser and minitrack observational data from GEOS-2 collected during the period April 23, 1971 to May 1971, have been used for the purpose of assessing the influence of tracking station location on the accuracy of orbit determination. These data were processed using a unified set of coordinates for the tracking station locations. Concurrently, these data were processed using nonunified station locations referred to a variety of geodetic datums. The resultant orbits based on the two different sets of station locations were compared and relative differences in the position of the satellite were determined. Differences between the two groups of orbits fitted over four-day data spans ranged from 250 meters to 500 meters for orbits derived from laser data only. For orbits observed from Minitrack data alone the relative differences in GEOS-2 spacecraft position ranged from 50 meters to 190 meters. Utilizing the laser data alone in each arc, definitive orbits were computed using the unified and nonunified station location coordinates. The differences in the satellite position in the overlap region when using the unified laser station coordinates ranged from 25 meters to 150 meters, whereas when using the nonunified laser station coordinates the differences in position ranges from 180 to 650 meters. Author

N72-30813*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SSS-A ATTITUDE CONTROL PRELAUNCH ANALYSIS AND OPERATIONS PLAN
R. D. Werking, J. Beck, D. Gardner, P. Moyer, and M. Plett Oct. 1971 180 p refs
(NASA-TM-X-65988; X-542-71-416) Avail: NTIS HC $11.00 CSCL 22D

A description of the attitude control support being supplied by the Mission and Data Operations Directorate is presented. Descriptions of the computer programs being used to support the mission for attitude determination, prediction, control, and definitive attitude processing are included. In addition, descriptions of the operating procedures which will be used to accomplish mission objectives are provided. Author

N72-30814*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
KINEMATICS OF THE HUYGENIAN REGION OF THE ORION NEBULA
D. Fischel and W. A. Feireman Aug. 1972 17 p refs
(NASA-TM-X-65994; X-670-72-291) Avail: NTIS HC $3.00 CSCL 03A

The nebular (O II) lambda 3726 and (O III) lambda 5007 radial velocity measures of Wilson, et al (1959) are presented in contour map form. The space motions of theta 1 and theta 2 Orionis and the nebular measures are discussed. Author

N72-30815*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVESTIGATION OF THE MARTIAN ENVIRONMENT BY INFRARED SPECTROSCOPY ON MARINER 9
Hansel R. Conrath, B. J. Conrath, W. Novis, V. Kunde, P. Lowman, W. Maguire, J. Pearl, J. Pirraglia, C. Prabhakara, B. Schlachman et al Jul. 1972 42 p refs Prepared in cooperation with Biospherics, Inc. and JPL
(NASA-TM-X-65993; X-620-72-280) Avail: NTIS HC $4.25 CSCL 03A

Measurements obtained during and after the planet-wide

dust storm indicate that large diurnal variations in atmospheric temperature existed up to at least 30 km; winds inferred from the temperature fields show a strong tidal component and significant ageostrophic behavior. With the dissipation of the dust, the daily maximum in the atmospheric temperature field moved from approximately latitude -60 and late afternoon local time to near the subsolar point in latitude and time. Analysis of spectral features due to the atmospheric dust indicates as SIO2 content of 60 ± 10%, implying that substantial geochemical differentiation has occurred. Water vapor estimates indicate abundances of 10 to 20 precipitable micrometers. Between November 1971 and April 1972 no gross latitudinal or temporal dependence in the water vapor distribution was detected from the south polar region to the equator. Water vapor was not detected over the north polar regions. Surface pressure mapping was carried out from which topographic relief of nearly two pressure scale heights is inferred. Extensive regions were found where the surface pressure exceeds the triple point pressure of water. Author

N72-30816*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD TRAJECTORY DETERMINATION SUBSYSTEM: MATHEMATICAL SPECIFICATIONS
W. E. Wagner, ed. (Computer Sciences Corp.) and C. E. Velez, ed. Mar. 1972 333 p refs
(NASA-TM-X-65984; X-552-72-244) Avail: NTIS HC $18.75 CSCL 22C

The mathematical specifications of the Goddard trajectory determination subsystem of the flight dynamics system are presented. These specifications include the mathematical description of the coordinate systems, dynamic and measurement model, numerical integration techniques, and statistical estimation concepts. Author

N72-30817*# Teledyne Brown Engineering, Huntsville, Ala.
SKYLAB EXPERIMENTAL PERFORMANCE EVALUATION MANUAL. APPENDIX Q: EXPERIMENT T-013 CREW/ VEHICLE DISTURBANCES (MSFC/LARC)
B. B. Tonetti 1 Aug. 1972 69 p refs
(Contract NAS8-21804)
(NASA-CR-61386-APP-Q) Avail: NTIS HC $5.50 CSCL 22C

A series of analyses to be used for evaluating the performance of the Skylab corollary experiments under preflight, inflight, and postflight conditions is given. Experiment contingency plan workaround procedure and malfunction analyses are presented in order to assist in making the experiment operationally successful. Author

N72-30818*# Analytical Mechanics Associates, Inc., Seabrook, Md.
RELATIVE MOTION OF ORBITING SATELLITES
J. B. Eades, Jr. [1972] 256 p refs
(Contract NAS1-10907)
(NASA-CR-112113; Rept-72-27) Avail: NTIS HC $15.00 CSCL 22C

The relative motion problem is analyzed, as a linearized case, and as a numerically determined solution to provide a time history of the geometries representing the motion state. The displacement history and the hodographs for families of solutions are provided, analytically and graphically, to serve as an aid to understanding this problem area. Linearized solutions to relative motion problems of orbiting particles are presented for the impulsive and fixed thrust cases. Second order solutions are described to enhance the accuracy of prediction. A method was developed to obtain accurate, numerical solutions to the intercept and rendezvous problem; and, special situations are examined. A particular problem related to relative motions, where the motion traces develop a cusp, is examined in detail. This phenomenon is found to be dependent on a particular relationship between orbital eccentricity and the inclination between orbital planes. These conditions are determined, and, example situations are presented and discussed. Author

N72-30819*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR EPHEMERIS AND SELENOGRAPHIC COORDINATES OF THE EARTH AND SUN FOR 1979 AND 1980
Ann D. Hartung 1972 442 p refs
(NASA-SP-3061) Avail: NTIS HC $6.00 CSCL 03A

Ephemeris data are presented in sections for each month for 1979 and 1980 to provide a time history of lunar coordinates and related geometric information. A NASA Manned Spacecraft Center modification of an ephemeris tape was used to calculate and plot coordinates of the earth, moon, and sun. The ephemeris is referenced to the mean vernal equinox at the nearest beginning of a Besselian year. Therefore, the reference equinox changes from one year to the next between 30 June and 1 July. The apparent discontinuity in the data is not noticeable in the graphical presentation, but can be observed in the digital output. The mean equator of epoch is used in all cases. The computer program used to compute and plot the ephemeris data is described in the appendix. Author

N72-30820*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR EPHEMERIS AND SELENOGRAPHIC COORDINATES OF THE EARTH AND SUN FOR 1977 AND 1978
Ann D. Hartung Washington 1972 442 p refs
(NASA-SP-3060) Avail: NTIS HC $6.00 CSCL 03A

Ephemeris data are presented in sections for each month for 1977 and 1978 to provide a time history of lunar coordinates and related geometric information. A NASA Manned Spacecraft Center modification of an ephmeris tape was used to calculate and plot coordinates of the earth, moon, and sun. The ephemeris is referenced to the mean vernal equinox at the nearest beginning of a Besselian year. Therefore, the reference equinox changes from one year to the next between June 30 and July 1. The apparent discontinuity in the data is not noticeable in the graphical presentation, but can be observed in the digital output. The mean equator of epoch is used in all cases. The computer program used to compute and plot the ephemeris data is described in the appendix. Author

N72-30821*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
JUPITER'S RADIATION BELTS AND THE SWEEPING EFFECT OF ITS SATELLITES
Gilbert D. Mead and Wilmot N. Hess (NOAA, Boulder, Colo.) Aug. 1972 64 p refs Submitted for publication
(NASA-TM-X-65986; X-641-72-274) Avail: NTIS HC $5.25 CSCL 03B

Jupiter's electron and proton radiation belts were analyzed, with particular reference to the effect of its five inner satellites, located within its magnetosphere. The characteristics of trapped electrons and protons with a magnetic moment of 50 MeV/gauss, considered typical at Jupiter, were calculated. The mean absorption time before impact was calculated for particles located at the radial distance of each of the satellites. A characteristic diffusion time near each satellite was calculated, assuming violation of the third invariant due to magnetic fluctuations associated with fluctuations in the solar wind. This diffusion time was found to be long compared with the absorption lifetimes at Europa and Amalthea. Author

N72-30822# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOVIET PROBES INVESTIGATE MARS
1972 7 p Transl. into ENGLISH from Pravda (USSR), no. 238(19746), 25 Aug. 1972
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The scientific investigation of Mars by Soviet Mars-2 and Mars-3 probes is discussed. Experiments were designed to cover interplanetary media, solar radiation, and the planet's composition. Experiments also cover temperature measurements of Martian soil and its surface, analysis of Martian relief, and atmospheric construction. E.H.W.

N72-30823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POGO OBSERVATIONS OF THE EQUATORIAL ELECTROJET
J. C. Cain and R. E. Sweeney Aug. 1972 146 p refs
(NASA-TM-X-65995; X-645-72-299) Avail: NTIS HC $9.50 CSCL 22C

During intervals in 1967 to 1970, the OGO-4 and 6 spacecraft made over 2000 traversals over the equatorial electrojet in the altitude range 400-800 km when local times were between 9 and 15 hours. These spacecraft carried total field magnetometers making measurements to an accuracy of 2 gamma with a sample rate greater than once a second. Delta F values, the deviations from these observations, were formed from an internal reference model. The results were plotted for a 30 deg band about the equator, and the characteristics of the electrojet effect in the data were investigated. This effect was characterized by a sharp negative V-signature of some 16-19 deg in width and a variable amplitude. The position of this minimum was found to lie within 0.5 deg of the dip equator. A slight northward shift was noted at the longitude of Huancayo. The jet amplitudes were normalized to 400 km amplitudes and observed to be highly variable in time. Amplitudes over the longitude range 50 to 90 deg W averaged 60% higher than elsewhere, as expected, due to the weaker main field. However, though the scatter of amplitudes is high, the expected minima in east Asia was not evident. It was speculated that this could be due to a less conducting upper mantle in this area. Author

N72-30824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ANALYTIC LUNAR AND SOLAR PERTURBATIONS OF A NEAR EARTH SATELLITE
Ronald H. Estes Aug. 1972 37 p refs
(NASA-TM-X-66000; X-645-72-297) Avail: NTIS HC $4.00 CSCL 22C

The disturbing function of the moon (sun) is expanded as a sum of products of two harmonic functions, one depending on the position of the satellite and the other on the position of the moon (sun). The harmonic functions depending on the position of the perturbing body are developed into trigonometric series with the ecliptic elements I, l', F, D, and Gamma of the lunar theory which are nearly linear with respect to time. Perturbation of elements are in the form of trigonometric series with the ecliptic lunar elements and the equatorial elements omega and Omega of the satellite so that analytic integration is simple and the results accurate over a long period of time. Author

N72-30825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRACKING COVERAGE OF THE RADIO ASTRONOMY EXPLORER-B
Hobart Swartwood, Jr. Aug. 1972 11 p refs Submitted for publication
(NASA-TM-X-65997; X-551-72-288) Avail: NTIS HC $3.00 CSCL 22C

Launch and arrival parameters for the Radio Astronomy Explorer-B mission were revised to provide better tracking station coverage of the transfer trajectory. It is shown that changing the launch azimuth and flight time is sufficient to provide postinjection tracking by Tananarive and Carnarvon, and redundant lunar orbit insertion coverage by command stations. These changes can be made with no significant influence on the other parameters and without sacrificing many launch opportunities. All acceptable launch opportunties during the RAE-B launch period are tabulated together with pertinent launch and arrival parameters. Author

N72-30826*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MISSION REQUIREMENTS SECOND SKYLAB MISSION, SL-3
1 Feb. 1972 185 p refs
(NASA-TM-X-68740; MSC-I-MRD-001E-Vol-2) Avail: NTIS HC $11.25 CSCL 22C

The Mission Requirements Document for the second Skylab Mission (SL-3) is presented. The following areas are defined: mission objectives, mission requirements, test objectives, medical experiments, Apollo telescope mount experiments, earth resources experiment package, and corollary experiments. F.O.S.

N72-30827*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATS C-2 SATELLITE VLBI EXPERIMENT
J. Ramasastry and B. M. Rosenbaum Jun. 1972 27 p refs
(NASA-TM-X-66001; X-553-72-252) Avail: NTIS HC $3.50 CSCL 22C

A proposal is presented to conduct a satellite VLBI experiment using the ATS C-2 spacecraft. The main objectives of the experiment are: (1) precision spacecraft position determination with the VLBI technique and comparison of the L-band interferometric technique with the L-band R and R technique from the viewpoint of operational simplicity and precision, (2) comparison of the single differential Doppler and the wideband VLBI technique for such uses as tracking, geodesy, etc., (3) derivation of real time ionospheric corrections and phase scintillation effects utilizing simultaneous two-frequency (L- and C-band) tracking of the spacecraft in both time delay and Doppler interferometry, (4) development of techniques for precise time dissemination, particularly to marine users, through wideband time-delay interferometry, (5) development of techniques to use synchronous satellites as stable platforms in space in the area of marine geodesy, (6) station location and calibration, and (7) aid to L-band navigation experiments which utilize precise spacecraft position and time in deriving the user's position. Author

N72-30828*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR EPHEMERIS AND SELENOGRAPHIC COORDINATES OF THE EARTH AND SUN FOR 1981 AND 1982
Ann D. Hartung Washington 1972 441 p refs
(NASA-SP-3062) Avail: NTIS HC $6.00 CSCL 03A

Ephemeris data are presented in sections for each month for 1981 and 1982 to provide a time history of lunar coordinates and related geometric information. A NASA Manned Spacecraft Center (MSC) modification of the Jet Propulsion Laboratory ephemeris tape was used to calculate and plot coordinates of the earth, moon, and sun. The ephemeris is referenced to the mean vernal equinox at the nearest beginning of a Besselian year. Therefore, the reference equinox changes from one year to the next between June 30 and July 1. The apparent discontinuity in the data is not noticeable in the graphical presentation, but can be observed in the digital output. The mean equator of epoch is used in all cases. For 1966 to 1970, the same type of data presentation has been prepared in informal MSC documents. The data for 1971 to 1980 and 1983 and 1984 are presented. The computer program used to compute and plot the ephemeris data is described. Author

N72-30829*# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
APPLICATIONS TECHNOLOGY SATELLITES ADVANCED MISSION STUDY Final Report
L. M. Gould Jul. 1972 406 p refs
(Contract NAS3-14359)
(NASA-CR-120872) Avail: NTIS HC $22.50 CSCL 22A

Three spacecraft configurations were designed for operation as a high powered synchronous communications satellite. Each spacecraft includes a 1 kw TWT and a 2 kw Klystron power amplifier feeding an antenna with multiple shaped beams. One of the spacecraft is designed to be boosted by a Thor-Delta launch vehicle and raised to synchronous orbit with electric propulsion. The other two are inserted into a elliptical transfer orbit with an Atlas Centaur and injected into final orbit with an apogee kick motor. Advanced technologies employed in the several

configurations include tubes with multiple stage collectors radiating directly to space, multiple-contoured beam antennas, high voltage rollout solar cell arrays with integral power conditioning, electric propulsion for orbit raising and on-station attitude control and station-keeping, and liquid metal slip rings.
Author

N72-30830*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FACE OF MARS MARINER 9
R. Steinbacker Jun. 1972 33 p
(Contract NAS7-100)
(NASA-CR-128028; JPL-TM-33-559) Avail: NTIS HC $3.75 CSCL 03B

A brief summary of salient science results obtained from the Mariner 9 mission through June 1972 are presented. The data are presented in the form of photographs, line drawings and graphs. Emphasis is placed on the composition of the south polar cap, the surface of the satellites, and the presence of clouds in the atmosphere. The size and configuration of topographical features are compared with similar earth structures for reference.
Author

N72-30831# Joint Publications Research Service, Arlington, Va.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 282
14 Aug. 1972 45 p refs Transl. into ENGLISH from various Sino-Soviet bloc periodicals
(JPRS-56761) Avail: NTIS HC $4.25

Translations and abstracts of articles on meteorology, oceanography, upper atmosphere and space research, and astronomy and terrestrial geophysics, covering both science news and formal scientific reports are reported. Published details of Soviet space spectaculars are included.
Author

N72-30832# Joint Publications Research Service, Arlington, Va.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE NO. 281
1 Aug. 1972 70 p refs Transl. into ENGLISH from various Soviet bloc publications
(JPRS-56650) Avail: NTIS HC $5.50

Translations and abstracts are given of articles on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial geophysics, covering both science news and formal scientific reports. Published details of Soviet space spectaculars are included.
Author

N72-30833# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO. 262
1 Aug. 1972 31 p Transl. into ENGLISH from Eastern European reports
(JPRS-56655) Avail: NTIS HC $3.75

Reviews are presented for Eastern European research in the mechanics of solids, antihail rockets, fluid mechanics, nuclear reactors, and the Fifth Internal Diseases Congress held in Sofia, Bulgaria.
K.P.D.

N72-30834# North American Rockwell Corp., Downey, Calif. Space Div.
HYPERBOLIC ORBIT EQUATIONS FOR ASYMPTOTE-BASED COORDINATES SYSTEMS
A. M. McDermott 24 Jun. 1971 21 p Backup document for AIAA Synoptic scheduled for publication in Journal of Spacecraft and Rockets, Dec. 1972
Avail: NTIS HC $3.25

Hyperbolic orbit equations were derived for state variables defined in polar and Cartesian coordinates referenced to one of the orbit asymptotes. The relations are computationally simple and allow all orbit state variables in both coordinate systems to be computed directly from any one of several variables. A simple time formula, expressed in the state variables in either coordinate frame, is derived. These relationships can be used as the basic orbit equations for any hyperbolic orbit computations. Preferred variables and coordinate systems for several applications are discussed, and useful approximations of the polar coordinate equations are given.
Author

N72-30835*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LINE-BLANKETED MODEL STELLAR ATMOSPHERES APPLIED TO SIRIUS Ph.D. Thesis - Maryland Univ.
John W. Fowler Aug. 1972 241 p refs
(NASA-TM-X-66005; X-670-72-303) Avail: NTIS HC $14.25 CSCL 03B

The primary goal of this analysis is to determine whether the effects of atomic bound-bound transitions on stellar atmospheric structure can be represented well in models. The investigation is based on an approach which is called the method of artificial absorption edges. The method is described, developed, tested, and applied to the problem of fitting a model stellar atmosphere to Sirius. It is shown that the main features of the entire observed spectrum of Sirius can be reproduced to within the observational uncertainty by a blanketed flux-constant model with T sub eff = 9700 K and Log g = 4.26. The profile of H sub gamma is reproduced completely within the standard deviations of the measurements except near line center, where non-LTE effects are expected to be significant. The equivalent width of H sub gamma, the Paschen slope, the Balmer jump, and the absolute flux at 5550 A all agree with the observed values.
Author

N72-30836# Joint Publications Research Service, Arlington, Va.
DETERMINING CIRCULAR ORBITS OF SATELLITES ACCORDING TO THE OBSERVATIONS FROM A SINGLE STATION
Yu. V. Surnin 18 Aug. 1972 14 p refs Transl. into ENGLISH from Geod. Kartografiya i Aerofotosyemka (USSR), no. 11, 1970 p 52-60
(JPRS-56805) Avail: NTIS HC $3.00

A general method is discussed for determining the osculating elements of elliptical orbits of geodetic satellites. The method is based on results of observations of topocentric directions for a satellite from one or several stations located in a limited area.
Author

N72-30837# National Environmental Satellite Center, Washington, D.C.
GEOSTATIONARY SATELLITE POSITION AND ATTITUDE DETERMINATION USING PICTURE LANDMARKS
William J. Dambeck Aug. 1972 23 p refs
(NOAA-TM-NESS-21) Avail: NTIS HC $3.25

Given a truly geostationary satellite, it is theoretically possible to determine both its position and attitude from the relative orientation of landmarks in pictures from the satellite. Several attempts to exploit this possibility are considered.
Author

N72-30838*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MOON VIEW PERIOD TABULATIONS (WITH STATION MASKING) FOR MANNED SPACE FLIGHT NETWORK STATIONS, BOOK 1 Technical Report, 1 Jan. - 1 Jul. 1973
M. M. Gattie and R. L. Williams Nov. 1970 144 p
(NASA-TM-X-68837) Avail: NTIS HC $9.25 CSCL 03A

The times during which MSFN stations can view the moon are tabulated. Station view periods for each month are given. All times and dates refer to Greenwich Mean Time. AOS and LOS refer to the center of the moon at zero degrees elevation for moon rise and set, respectively.
Author

N72-30839# Mons Univ. (Belgium). Dept. d'Astrophysique.
BRIGHT STARS CHARTS IN ECLIPTIC COORDINATES WITH MAGNITUDES AT 2000 ANGSTROMS
Leo Houziaux and Gerard Houziaux 1972 14 p
(Commun-26) Avail: NTIS HC $3.00

A complete chart of the sky is presented in 1970 ecliptic coordinates for bright objects in the ultraviolet with computed magnitudes at 2000 A. The spectral types represented are O, B, A, F, and G. The Bayer and Flamsteed designations were added, as well as several nonstellar objects. ESRO

N72-30840# Academy of Sciences (USSR), Moscow.
RESULTS OF RADAR EXPERIMENTS PERFORMED ON AUTOMATIC STATIONS LUNA-16 AND LUNA-17
N. N. Kroupenio 1972 15 p refs Presented at the 15th COSPAR Meeting, Madrid, May 1972
(D-131) Avail: NTIS HC $3.00

Using 3 cm-radio altimeters the specific radar cross section sigma sub zero and back scattering law B(theta) in the regions of the landing sites of Luna 16 and Luna 17 lunar probes were measured to determine the characteristics of radio waves scattered by the lunar surface. Lunar rock density and dielectric permeability were calculated. The density results are compared with measurements from earth. ESRO

N72-30841# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
SORPTION PROCESSES ON THE LUNAR SURFACE
V. A. Kotchnev, M. D. Nussinov, E. M. Rudnitzki, Y. A. Surkov, V. V. Shvarev, and I. L. Ettinger 1972 11 p refs Presented at the 15th COSPAR Meeting, Madrid, 1972
(D-132) Avail: NTIS HC $3.00

Adsorption-desorption processes on the lunar surface were studied, based on lunar dust samples with nitrogen as the test gas, taking into account the value of the specific surface of a regolith dust fraction. It is considered that the sorption process could lead to diurnal variations in pressure of the lunar atmosphere. ESRO

N72-30842# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
PRELIMINARY RESULTS OF MEASUREMENTS OF UV-EMISSION SCATTERED IN THE MARTIAN UPPER ATMOSPHERE
N. N. Dementyeva, V. G. Kurt, A. S. Smirnov, L. G. Titarchuk, and S. D. Chuvahin 1972 20 p refs
(D-139) Avail: NTIS HC $3.00

The results of measurements of scattered UV emission in the Martian upper atmosphere in three spectral ranges taken by Mars 2 and 3 spacecraft are presented. A model of the neutral hydrogen distribution in the Martian atmosphere was constructed using radiative transfer theory; observed results are in good agreement with theoretical calculations of intensities. ESRO

N72-30843# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
PRELIMINARY RESULTS OF THE ASTROPHYSICAL OBSERVATIONS OF MARS FROM AIS MARS-3
V. I. Moroz and L. V. Ksanfomaliti 1972 37 p refs
(D-142) Avail: NTIS HC $4.00

Preliminary results of measurements from experiments on Mars 3 spacecraft during March-December are presented. The instruments used for studying the Martian surface and lower atmosphere were an IR-radiometer, a narrow band photometer for CO2 spectroaltimetry, a narrow band photometer for measurement of water vapor content, and a photometer for measurements of the brightness distribution over the planet. ESRO

N72-30844# Yale Univ., New Haven, Conn.
SUFFICIENT CONDITIONS FOR RETURN IN THE THREE BODY PROBLEM
E. Myles Standish, Jr. Apr. 1972 11 p ref
(Contract N00014-67-A-0097-0018; Grant NSF GP-26495; NR Proj. 044-239)
(AD-740229) Avail: NTIS CSCL 03/3

Sufficient conditions are given, which, if fulfilled, enable one to determine, rigorously, that an ejected particle will not escape from a three-body system. Author (GRA)

N72-30845# Little (Arthur D.), Inc., Cambridge, Mass.
PREDICTION AND ANALYSIS OF SOLAR ECLIPSE CIRCUMSTANCES: ERRATA AND ADDENDA
Wentworth Williams, Jr. 25 Mar. 1971 16 p
(AD-740112; AFCRL-71-0049-1) Avail: NTIS CSCL 03/3

In the course of determining solar eclipse circumstances for ionospheric and atmospheric studies, it became apparent that the solar and lunar longitude and the lunar parallax developments were not of sufficient accuracy. Consequently, terms with coefficients down to and including 0.025 seconds in longitude, and down to and including 0.001 seconds in parallax, have been restored. GRA

N72-30846# Texas Univ., Austin. Dept. of Astronomy.
THE VELOCITY-DISTANCE RELATION FOR BRIGHT GALAXIES
G. DeVaucouleurs 1972 11 p refs Presented at Padua Conf. on Cosmology, Italy, 1 Sep. 1964
(Contract Nonr-375(13); NR Proj. 046-785)
(AD-740667) Avail: NTIS CSCL 03/1

The survey of the velocity-distance relation for bright galaxies was prepared as part of a continuing program of red-shift observations at McDonald Observatory. GRA

N72-30847# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
A HIGH-FREQUENCY STUDY OF CYGNUS A
Ka Bing W. Yip and G. A. Seielstad 1972 30 p refs
(Contract N00014-67-A-0094-0019)
(AD-740395; Rept-1972-1) Avail: NTIS CSCL 03/2

Measurements at 8300 and 9600 MHz are combined to map the distribution of total radiation across Cygnus A with a beam of half-power width about 20 seconds EW x 30 seconds NS. Steep brightness contours are noted on the outer edges and more gradual inner extensions towards the optical galaxy. The brightest peaks within each radio component have flatter spectra than the rest of the source. The distributions of linearly polarized radiation at both 8300 and 9600 MHz are also mapped. Nearly everywhere in the source the degree of polarization at 9600 MHz exceeds that at 8300 MHz. The rotation measures vary more or less systematically across Cygnus A from a very large negative value at the following edge to a positive value on the preceding edge. Author (GRA)

N72-30848# California Inst. of Tech. Pasadena. Owens Valley Radio Observatory.
GROSS PROPERTIES OF FIVE SCD GALAXIES AS DETERMINED FROM 21 CM OBSERVATIONS
D. H. Rogstad and G. S. Shostak 1972 21 p refs
(Contract N00014-67-A-0094-0019; Grant NSF GP-30400)
(AD-740396; Rept-1972) Avail: NTIS CSCL 03/2

Neutral hydrogen studies of the five Scd galaxies M33, NGC 2403, IC342, M101 and NGC6946 have revealed substantial similarities in their hydrogen distributions and rotation curves. It is found that about 80% of the observable HI lies within the boundary defined by the Holmberg diameter for each galaxy. The ratio of the HI mass to the total mass contained within this same boundary has a mean value of about 0.11. The central HI surface density is also nearly a constant within the Scd classification. We find that all the HI global properties and ratios are nearly constant or scale approximately with Holmberg radius or total mass. An observed correlation of maximal rotation velocity with Holmberg radius allows characterization of the total mass with only one parameter. Because of the very flat rotation

curves observed for these Scd galaxies, total masses extrapolated to infinite radius are not known. Surface mass-luminosities ratios must reach values of about 20 at the Holmberg radius.
Author (GRA)

N72-30849# McDonald Observatory, Austin, Tex.
A NEW INTERPRETATION OF THE SPIRAL GALAXY NGC 2146
G. DeVaucouleurs 1971 21 p refs
(Contract Nonr-375(13); NR Proj. 046-795)
(AD-740669) Avail: NTIS CSCL 03/1

NGC 2146 is a peculiar-looking spiral galaxy. It has been variously classified as Ir, Sap, Sbcp, SBbc, and SBc. The wide range of estimates shows the difficulty of fitting it in one of the regular types. The cause of the difficulty lies in the fact that the galaxy has apparently a third arm and that the arms are not coplanar. A second peculiarity is the abnormal rotation curve observed which indicates the presence of large departures from circular motion about 20 seconds from the nucleus along the major axis. The report gives a new interpretation of the structure and rotation curve of NGC 2146. GRA

N72-30850# Institute for Advanced Study, Princeton, N.J.
PROBLEMS OF STAR FORMATION
L. Mestel 1972 63 p refs
(Contract Nonr-1858(33); NR Proj. 046-776)
(AD-740680) Avail: NTIS CSCL 03/2

The lectures deal mainly with the condensation of self-gravitating masses of gas from cosmic clouds, with special attention to difficulties due to angular momentum and a magnetic field. Emphasis is laid on the dynamical problems of the early stages, before opacity becomes important.
Author (GRA)

N72-30851# Institute for Advanced Study, Princeton, N.J.
COMPARISON OF THE HYADES, COMA, AND PLEIADES CLUSTERS BASED ON PHOTOELECTRIC u,v,b,y AND H beta
David L. Crawford (Kitt Peak Natl. Obs., Tucson, Ariz.) and Bengt Stroemgren 1972 20 p refs Submitted for publication Sponsored in part by NSF
(Contract Nonr-1855(33); NR Proj. 046-776)
(AD-740679) Avail: NTIS CSCL 03/2

The comparison of the Hyades and Coma clusters is based on photoelectric u, v, b, y, and H Beta photometry of 79 Hyades members and 35 Coma cluster stars. Author

N72-30852# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
LONG-PERIOD SATELLITE PERTURBATIONS UNDER THE ACTION OF SOLAR RADIATION PRESSURE
E. N. Polyahkhova 21 Apr. 1971 17 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat. Mekhan. i Astron. (USSR), v. 25, no. 7, 1970 p 144-152
(Contract N00017-72-C-4401)
(AD-740889; APL-CLB-3-T-647) Avail: NTIS CSCL 22/3

The long-period perturbations of the orbital elements of satellites caused by direct solar radiation pressure are considered for satellites of high area-to-mass ratio. A series of orbits is selected to illustrate the main perturbation effects. The graphs are drawn up neglecting planet asphericity and the effects of shadowing. Author (GRA)

N72-30853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC AND TECHNICAL EXPERIMENTS ONBOARD SOYUZ-9
V. I. Sevastyanov 25 Jan. 1972 23 p Transl. into ENGLISH from Russian Report
(AD-740354; FTD-MT-24-34-72) Avail: NTIS CSCL 22/1

The flight engineer of SOYUZ-9, V. I. Sevastyanov, briefly describes some of the experiments conducted by the crew during the 18-day flight. Three main areas were examined during the flight-testing of space technology and life support systems during a long-term flight; study of the crew capabilities and study of readaption to gravity; and accomplishment of extensive complex of scientific, technical, medical-biological studies and experiments.
Author (GRA)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N72-30854*# Applied Dynamics Research Corp., Huntsville, Ala.
DESIGN, DEVELOP, FABRICATE, ASSEMBLE AND CHECKOUT AND ADVANCED ACTIVE DAMPER SYSTEM Final Report, 18 Nov. 1970 - 31 Mar. 1971
C. S. Chang 31 Mar. 1972 105 p refs
(Contract NAS8-26593)
(NASA-CR-127815; T-1008F) Avail: NTIS HC $7.25 CSCL 22B

An active electromagnetic damper system was developed for and used in a 5.5% aeroelastic model of Saturn 1B/SA206 launch configuration in wind tunnel tests to determine ground wind-induced loads. Detailed descriptions are given of the damper development program: approach, design analyses, fabrication, checkout, system calibration, wind tunnel test results, damper assembly and operating instructions, and trouble-shooting procedures. Conclusions and recommendations to improve the damper system for future applications are also presented.
Author

N72-30855*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SIMULATION OF A FLEXIBLE SPINNING VEHICLE Final Report
W. A. Baudry Jul. 1972 104 p
(Contract NAS8-26700)
(NASA-CR-123789; MDC-G2968) Avail: NTIS HC $7.52 CSCL 22B

Results are presented of experimental investigation of the controlled and uncontrolled dynamical behavior of a rotating or artificial gravity space station including flexible body effects. A dynamically scaled model was supported by a spherical air bearing which provided a nearly moment free environment. Reaction jet system were provided for spin-up and spin-down and for damping of wobble motion. Two single-gimbal gyros were arranged as a control moment gyro wobble damping system. Remotely controllable movable masses were provided to simulate mass shift disturbances such as arise from crew motions. An active mass balance wobble damping system which acted to minimize the wobble motions induced by crew motions was also installed. Flexible body effects were provided by a pair of inertia augmentation booms. Inertia augmentation booms are contemplated for use on rotating space stations to cause the spin axis moment of inertia to be the largest of the three moments of inertia as is necessary to assure gyroscopic stability. Test runs were made with each of the control systems with the booms locked (rigid body) and unlocked (flexible body). Author

N72-30856*# Technology, Inc., Dayton, Ohio. Information Systems Div.
APPLICATION OF THE QSDC PROCEDURE TO THE FORMULATION OF SPACE SHUTTLE DESIGN CRITERIA. VOLUME 1: STUDY EFFORT Final Report, 13 Apr. 1971 - 31 Mar. 1972

Innes Bouton and Gary L. Martin Jun. 1972 30 p refs
(Contract NAS8-26918)
(NASA-CR-123787; TI-425-72-14-Vol-1) Avail: NTIS HC $3.50 CSCL 22B

Criteria to determine the probability of aircraft structural failure were statistically established according to the Quantitative Structural Design Criteria by Statistical Methods, the QSDC procedure. Since an Application Guide is needed to use the QSDC procedure, most of the study was directed to the development of this guide. Most of the considerations followed in the development of the Applications Guide and the Guide itself are reported. Author

N72-30857*# Technology, Inc., Dayton, Ohio. Informations Systems Div.
APPLICATION OF THE QSDC PROCEDURE TO THE FORMULATION OF SPACE SHUTTLE DESIGN CRITERIA. VOLUME 2: APPLICATIONS GUIDE Final Report, 13 Apr. 1971 - 13 Mar. 1972
Innes Bouton and Gary L. Martin Jun. 1972 113 p refs
(Contract NAS8-26918)
(NASA-Cr-123786; TI-425-72-14-Vol-2) Avail: NTIS HC $7.75 CSCL 22B

Criteria to determine the probability of aircraft structural failure were established according to the Quantitative Structural Design Criteria by Statistical Methods, the QSDC Procedure. This criteria method was applied to the design of the space shuttle during this contract. An Applications Guide was developed to demonstrate the utilization of the QSDC Procedure, with examples of the application to a hypothetical space shuttle illustrating the application to specific design problems. Discussions of the basic parameters of the QSDC Procedure: the Limit and Omega Conditions, and the strength scatter, have been included. Available data pertinent to the estimation of the strength scatter have also been included. Author

N72-30858*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
COMMAND MODULE/SERVICE MODULE REACTION CONTROL SUBSYSTEM ASSESSMENT
Dwayne P. Weary Jun. 1971 638 p
(NASA-TM-X-68578; MSC-03432) Avail: NTIS HC $34.00 CSCL 22B

Detailed review of component failure histories, qualification adequacy, manufacturing flow, checkout requirements and flow, ground support equipment interfaces, subsystem interface verification, protective devices, and component design did not reveal major weaknesses in the command service module (CSM) reaction control system (RCS). No changes to the CSM RCS were recommended. The assessment reaffirmed the adequacy of the CSM RCS for future Apollo missions. Author

N72-30859*# General Dynamics Corp., San Diego, Calif. Convair Aerospace Div.
A METHOD FOR DETERMINING THE RESPONSE OF SPACE SHUTTLE TO ATMOSPHERIC TURBULENCE. VOLUME 2: COMPUTER PROGRAM DESCRIPTION AND USAGE INSTRUCTIONS
R. Huntington and R. Haller Dec. 1971 96 p ref
(Contract NAS8-26363)
(NASA-CR-123788; GDC-DDE71-002-Vol-2) Avail: NTIS HC $7.00 CSCL 22A

A description is given of a computer program which calculates the response of an elastic aerospace vehicle to random and discrete turbulence. The program uses vibration modes as generalized coordinates. Inputs to the program include modal information, generalized aerodynamic forces, flight data, stability augmentation system description, and description of the disturbing function. Program outputs include tabulations of the ratio of root-mean-square response to root-mean-square turbulence and response upward zero crossings per second, and SC4020 plots of transfer functions, response power spectral densities, and Nyquist stability traces. Author

N72-30860*# Southwest Research Inst., San Antonio, Tex.
SYNTHESIS OF SHUTTLE VEHICLE DAMPING USING SUBSTRUCTURE TEST RESULTS Interim Report
Daniel D. Kana and Stephen Huzar Jun. 1972 108 p refs
(Contract NAS8-27569; SWRI Proj. 02-3131)
(NASA-CR-123791) Avail: NTIS HC $7.50 CSCL 22B

An empirical method is developed for predicting the modal damping of a combined parallel-stage shuttle model by means of damping measurements performed on the individual substructures. Correlations are first determined for each component in terms of damping energy as a function of peak kinetic energy and modal amplitude. The results are then used to predict component damping energies corresponding to the respective kinetic energies and amplitudes that occur for the new modes of the combined system. Modal characteristics for the system, other than damping, are obtained by a real eigenvalue solution of dynamic equations developed by Hurty's procedure of substructures. System equations, which include component modal damping, are also solved by a complex eigenvalue approach for comparison with results of the empirical method. Author

N72-30861*# General Dynamics Corp., San Diego, Calif. Convair Aerospace Div.
RESEARCH AND APPLICATIONS MODULES (RAM), PHASE B STUDY
12 May 1972 287 p refs
(Contract NAS8-27539)
(NASA-CR-123785; DPD-239; GDCA-DDA72-007) Avail: NTIS HC $16.50 CSCL 22B

The research and applications modules (RAM) system is discussed. The RAM is a family of payload carrier modules that can be delivered to and retrieved from earth orbit by the space shuttle. The RAM's capability for implementing a wide range of manned and man-tended missions is described. The rams have evolved into three types; (1) pressurized RAMs, (2) unpressurized RAMs, and (3) pressurizable free-flying RAMs. A reference experiment plan for use as a baseline in the derivation and planning of the RAM project is reported. The plan describes the number and frequency of shuttle flights dedicated to RAM missions and the RAM payloads for the identified flights. Author

N72-30862*# Rensselaer Polytechnic Inst., Troy, N.Y. School of Engineering.
ANALYSIS AND DESIGN OF A CAPSULE LANDING SYSTEM AND SURFACE VEHICLE CONTROL SYSTEM FOR MARS EXPLORATION Progress Report, 1 Jul. 1971 - 30 Jun. 1972
D. K. Frederick, P. K. Lashmet, G. N. Sandor, C. N. Shen, E. J. Smith, and S. W. Yerazunis 30 Jun. 1972 130 p refs
(Grant NGL-33-018-091)
(NASA-CR-127862; RPI-TR-MP-28) Avail: NTIS HC $8.50 CSCL 22B

The problems related to the design and control of a mobile planetary vehicle to implement a systematic plan for the exploration of Mars were investigated. Problem areas receiving attention include: vehicle configuration, control, dynamics, systems and propulsion; systems analysis; navigation, terrain modeling and path selection; and chemical analysis of specimens. The following specific tasks were studied: vehicle model design, mathematical modeling of dynamic vehicle, experimental vehicle dynamics, obstacle negotiation, electromechanical controls, collapsibility and deployment, construction of a wheel tester, wheel analysis, payload design, system design optimization, effect of design assumptions, accessory optimal design, on-board computer subsystem, laser range measurement, discrete obstacle detection, obstacle detection systems, terrain modeling, path selection system simulation and evaluation, gas chromatograph/mass spectrometer system concepts, chromatograph model evaluation and improvement and transport parameter evaluation. Author

N72-30863*# Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.
AIR DATA MEASUREMENT SYSTEM FOR SPACE SHUTTLE

Interim Report
J. C. DeJesus, Delroy J. Sowada, and Fred A. Moynihan 27 Jul. 1972 182 p refs
(Contract NAS8-26326)
(NASA-CR-123812) Avail: NTIS HC $11.25 CSCL 22B

It is concluded that air data measurements of angle of attack and sideslip are needed to control the space shuttle vehicles. The basis for this conclusion, along with recommended sensor design and implementation, are described. Author

N72-30864*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
SPACE SATELLITE DYNAMICS WITH APPLICATIONS TO SUNLIGHT PRESSURE ATTITUDE CONTROL Ph.D. Thesis
Barton W. Stuck 2 Aug. 1972 135 p refs
(Grant NGL-22-009-019)
(NASA-CR-127869; CSR-T-72-2) Avail: NTIS HC $8.75 CSCL 22C

A research program into three aspects of space satellite dynamics was carried out. First, a four-dimensional space-time formulation of Newtonian mechanics is developed. This theory allows a new physical interpretation of the conservation theorems of mechanics first derived rigorously by Noether. Second, a new concept for estimating the three angles which specify the orientation in space of a rigid body is presented. Two separate methods for implementing this concept are discussed, one based on direction cosines, the other on quaternions. Two examples are discussed: constant orientation in space, and constant rate of change of the three angles with time. Third, two synchronous equatorial orbit communication satellite designs which use sunlight pressure to control their attitude are analyzed. Each design is equipped with large reflecting surfaces, called solar sails, which can be canted in different directions to generate torques to correct pointing errors. Author

N72-30865*# National Aeronautics and Space Administration, Washington, D.C.
NASA SPACE SHUTTLE TECHNOLOGY CONFERENCE: DYNAMICS AND AEROELASTICITY; STRUCTURES AND MATERIALS Progress Report
Jul. 1972 785 p refs Conf. held in San Antonio, 12-14 Apr. 1972 in conjunction with the AIAA/ASME/SAE 13th Struct., Structural Dyn. and Mater. Conf.
(NASA-TM-X-2570; L-8393; PR-3) Avail: NTIS HC $9.00 CSCL 22B

Space shuttle technologies considered are applicable to the areas of: Aeroelasticity and loads, structure/liquid interactions, vehicle dynamic test and analysis, thermal protection systems, structural design and construction materials. For individual titles, see N72-30866 through N72-30888.

N72-30866* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER TECHNOLOGY FOR SPACE SHUTTLE
Robert C. Goetz *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 1-24 refs (For availability see N72-30865 21-31)
CSCL 22B

The development of analytical and experimental techniques needed to predict space shuttle flutter boundaries and insure adequate flutter margins and anticipated problems associated with aeroelastic-model and full-scale testing to validate flutter clearance are considered. Results illustrating the best available tools for subsonic and supersonic flutter prediction are presented. Programs currently underway which will help overcome the difficult problems envisioned for the transonic wind-tunnel and flight flutter test program are also discussed. Author

N72-30867* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASSESSMENT OF POTENTIAL BUFFET PROBLEMS ON THE SPACE SHUTTLE VEHICLE
Lado Muhlstein, Jr. *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 25-43 (For availability see N72-30865 21-31)
CSCL 22B

Buffet of the space shuttle launch and reentry configuration is an area requiring continued evaluation to produce a safe reliable vehicle of minimum weight. Buffet forces result from flow separation and therefore can not be predicted accurately. Buffet loads are highly sensitive to configuration, angle of attack, and Mach number and can be reliably determined only by wind tunnel tests of elastically scaled models. Author

N72-30868* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRUCTURAL DAMAGE CLAIMS RESULTING FROM ACOUSTIC ENVIRONMENTS DEVELOPED DURING STATIC TEST FIRING OF ROCKET ENGINES c27
Stanley H. Guest and Robert M. Slone, Jr. *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 45-69 (For availability see N72-30865 21-31)
CSCL 21H

During static testing of multi-million pound thrust rocket engines areas adjacent to the test site have been subjected to the noise generated by rocket engines. Structural damage claims and subjective complaints were filed by those who alleged that the noise levels were excessive. The statistical analysis of these claims and complaints which were filed during these rocket engine development programs led to the determination of a relationship between claims and overall sound pressure level. Community exposure criteria are then assessed based on what can be considered allowable acoustic environments from large rocket engines. Author

N72-30869* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IN-FLIGHT AEROACOUSTIC ENVIRONMENTS ON PROSPECTIVE SPACE SHUTTLE VEHICLES c01
Jules B. Dods, Jr. and Richard D. Hanly *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 71-96 refs (For availability see N72-30865 21-31)
CSCL 22C

The problem of in-flight aerodynamic noise has been studied by reliable estimates of full scale surface-pressure fluctuations from scale model tests in wind tunnels. Scaling relationships have been verified, and many details of the fluctuating pressure characteristics such as spatial correlation and convection velocities are understood. The effects of the wind tunnel environmental turbulence and noise have also been investigated sufficiently so that threshold levels of usable data are known. Author

N72-30870* Aerospace Corp., El Segundo, Calif.
NEW CONSIDERATIONS FOR POGO PREVENTION ON SPACE SHUTTLE
S. Rubin *In* NASA, Washington NASA Space Shuttle Technol. Conf. Jul. 1972 p 97-116 refs (For availability see N72-30865 21-31)
CSCL 22B

Recommendations for improving the methodology of pogo suppression for the space shuttle include: Consideration of inter-pump location for accumulator or active device, inclusion of tank outflow effects in dynamic structural analysis, the use of simplified transfer functions in systems studies, three phase dynamic testing program for turbopump with development of dynamic flowmeters, and the use of a linearized mathematical model for engine physics studies. G.G.

N72-30871* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OVERVIEW OF TECHNOLOGY RELATIVE TO THE POGO INSTABILITY ON SPACE SHUTTLE
Larry D. Pinson and John E. Harbison *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 117-138 refs (For availability see N72-30865 21-31)
CSCL 22B

The prediction of pogo contains a major source of uncertainty in the difficulty of defining the dynamic characteristics of certain components. An overview of the space shuttle technology with respect to each the following pogo problem areas is presented: structure, tank-liquid interaction, feedline, engine (pump), pogo-loop/control-loop interaction, and stability analysis. G.G.

N72-30872* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LIQUID-PROPELLANT DYNAMICS AND SUPPRESSION c12
David G. Stephens and Larry A. Kiefling *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 139-174 refs (For availability see N72-30865 21-31)
CSCL 20D

Technology related to liquid-propellant interactions with space shuttle vehicles is reviewed. Potential problems unique to the shuttle include liquid-structure interactions resulting from coupled lateral and longitudinal deformations, traveling wave phenomena at shallow propellant levels, and liquid impact during abort, staging, or docking. Technology efforts to define the slosh dynamics under shuttle operating conditions are described with emphasis on analytical representations of the liquid by finite-element and marker-and-cell methods. In addition, slosh suppression is discussed and includes baffle damping and pressure loads for tanks fitted with multiple baffles both above and below the undisturbed liquid surface. Author

N72-30873* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLIGHT LOADS AND CONTROL
David K. Mowery and Stephen W. Winder *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 175-203 (For availability see N72-30865 21-31)
CSCL 22B

The prediction of flight loads and their potential reduction, using various control logics for the space shuttle vehicles, is very complex. Some factors, not found on previous launch vehicles, that increase the complexity are large lifting surfaces, unsymmetrical structure, unsymmetrical aerodynamics, trajectory control system coupling, and large aeroelastic effects. Discussed are these load producing factors and load reducing techniques. Identification of potential technology areas is included. Author

N72-30874* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC ANALYSIS FOR SHUTTLE DESIGN VERIFICATION
Robert W. Fralich, Claude E. Green, and Mario H. Rheinfurth *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 205-230 refs (For availability see N72-30865 21-31)
CSCL 22B

Two approaches that are used for determining the modes and frequencies of space shuttle structures are discussed. The first method, direct numerical analysis, involves finite element mathematical modeling of the space shuttle structure in order to use computer programs for dynamic structural analysis. The second method utilizes modal-coupling techniques of experimental verification made by vibrating only spacecraft components and by deducing modes and frequencies of the complete vehicle from results obtained in the component tests. G.G.

N72-30875* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DYNAMIC TESTING FOR SHUTTLE DESIGN VERIFICATION
Claude E. Green, Sumner A. Leadbetter, and Mario H. Rheinfurth *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 231-265 (For availability see N72-30865 21-31)
CSCL 22B

Space shuttle design verification requires dynamic data from full scale structural component and assembly tests. Wind tunnel and other scaled model tests are also required early in the development program to support the analytical models used in design verification. Presented is a design philosophy based on mathematical modeling of the structural system strongly supported by a comprehensive test program; some of the types of required tests are outlined. G.G.

N72-30876* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ASSESSMENT OF RADIATIVE METALLIC THERMAL PROTECTION SYSTEMS FOR SPACE SHUTTLE c33
Bland A. Stein, Herman L. Bohon, and Donald R. Rummler *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 267-302 (For availability see N72-30865 21-31)
CSCL 20M

The metallic thermal protection system technology program for the space shuttle is reviewed for the areas of environmental uncertainties, materials data base, TPS design concepts and heat-shield panel configurations, testing and evaluation of materials, panels, and complete systems. Author

N72-30877* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THERMAL PROTECTION SYSTEM TRADE STUDIES ON ABLATORS AND REUSEABLE SURFACE INSULATION c33
George Strouhal and Donald M. Curry *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 303-334 (For availability see N72-30865 21-31)
CSCL 20M

Analytical trade studies are presented that consider passive TPS configurations using the following material categories: (1) reuseable surface insulation - surface-coated rigidized ceramic fiber; (2) low density charring ablators; and (3) carbon-carbon and high density ablators for leading edge areas. Emphasized are effects on TPS weight by variations in entry trajectories and material thermal characteristics. Author

N72-30878* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OXIDATION PROTECTED CARBON-CARBON c33
James E. Pavlosky and Leslie G. St Leger *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 335-372 (For availability see N72-30865 21-13)
CSCL 20M

Pyrolized carbon-carbon has one unique advantage over other materials that makes its application to the space shuttle thermal protection system very attractive. This unique characteristic is the increase in material strength and modulus with increase in temperature up to about 2500 K (4040 F). Offsetting this unique advantage are disadvantages which include brittleness, high cost, and the tendency of the material to react with oxygen, particularly at high temperatures. The development of an oxidation inhibitor for the material and the definition of fabrication processes for selected full-scale components are considered. Author

N72-30879* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REUSABLE SURFACE INSULATION MATERIALS RESEARCH AND DEVELOPMENT c33
Howard E. Goldstein, John D. Buckley, Harry M. King, Hubert B. Probst, and Ivan K. Spiker *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 373-433 (For availability see N72-30865 21-31)
CSCL 20M

Reusable surface insulation is considered a prime candidate for heat shielding large areas of the space shuttle vehicle. The composition and fabrication of RSI materials are discussed, followed by evolution of RSI and current problems, physical and thermal properties, arc plasma test data and results, and material improvement research. Finally, a summary of RSI technology status is presented. Author

N72-30880* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
STATUS OF REUSABLE SURFACE INSULATION THERMAL PROTECTION SYSTEM TECHNOLOGY PROGRAMS
David H. Greenshields, Andre J. Meyer, and Donald J. Tillian *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 435-474 (For availability see N72-30865 21-31)
CSCL 22B

The development of three low-density rigidized insulation materials for the shuttle TPS application is reported. These materials consist of one high purity silica system and two systems based on mullite, an aluminum silicate. Both systems consist of fibers joined together with appropriate binders to obtain a rigidized insulation composite. Both material systems require the application of a glassy coating to provide a wear resistant, high emittance surface and to prevent the absorption of water by the fiber matrix. The technology program has addressed the development of water impervious coatings, methods of assembling the materials in design concepts while minimizing the thermal stress in the insulation, achieving compatibility between the RSI material and the structural system, and test evaluations to demonstrate the feasibility of the surface insulation concept. Author

N72-30881* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ABLATOR MANUFACTURING **c33**
Claud M. Pittman and William D. Brewer *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 475-504 refs (For availability see N72-30865 21-31)
CSCL 20M

Studies are being conducted to determine how manufacturing-induced defects affect the performance of ablative heat shields. If commonly occurring defects do not affect material performance, simpler manufacturing techniques can be used, quality control requirements can be relaxed, repair and rework operations can be held to a minimum, and thus the total manufacturing cost can be reduced. Author

N72-30882* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MATERIALS AND DESIGN FOR ABLATIVE HEAT SHIELDS **c33**
Marvin B. Dow, Stephen S. Tompkins, and Frank Coe *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 505-536 refs (For availability see N72-30865 21-31)
CSCL 20M

The goal of the ablation technology program is to bring ablation research and development to a high state of readiness for application to space shuttle vehicles. Some recent results and current work in the areas of materials, designs, and refurbishment for ablative TPS are reported. Future research and development needs are also presented. Author

N72-30883* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED DESIGN CONCEPTS FOR SHUTTLE AIRFRAME STRUCTURE
Michael F. Card, John G. Davis, Jr., and John L. Shideler *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 537-572 ref (For availability see N72-30865 21-31)
CSCL 22B

The development of weight-saving advanced design concepts for shuttle airframe structure is presented. Design concepts under investigation employ selective composite reinforcement and/or efficient geometric arrangements. An effort to develop metallic panel designs which exploit the relaxation of smooth external-surface requirements for skin structure is reviewed. Available highlights from research and development studies which investigate the application of composite reinforcement to the design of two types of fuselage panels, a shear web, a large fuselage frame, and a landing-gear-door assembly are presented. Preliminary results from these studies suggest weight savings of 25 percent can be obtained. Author

N72-30884* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF COMPOSITE MATERIALS TO SPACE SHUTTLE TANKS
James R. Faddoul *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 573-603 refs (For availability see N72-30865 21-31)
CSCL 22B

Tanks are broken down into two categories: pressure vessels that carry primarily pressure loads, and structural tanks that carry structural loads such as thrust or bending in addition to pressure. A significant portion of the shuttle orbiter structure are tanks and in order to minimize both weight and cost growth on these shuttle tank structures, composite material tanks of both types are considered. Author

N72-30885* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPOSITE SYSTEMS UTILIZATION FOR SPACE SHUTTLE STRUCTURES
E. E. Engler and O. D. Meredith *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 605-644 (For availability see N72-30865 21-31)
CSCL 22B

Research and development of composite material systems to show applicability of these materials to shuttle structures and to demonstrate availability through a hardware development program is reported. The various configurations studied and potential areas of composite structures use are described and an outline of ongoing composite programs, complementing the indicated feasible applications, including a typical cost study, is shown. The following composite systems are investigated: Boron filaments with epoxy, polyimide, or aluminum matrix, and graphite filaments with epoxy or polyimide matrix. Author

N72-30886* European Space Vehicle Launcher Development Organization, Paris (France).
EUROPEAN TECHNOLOGY ON COMPOSITE MATERIALS **c18**
J. Fray (Hawker Siddeley Dyn. Ltd.), A. W. Kitchenside (Brit. Aircraft Corp.), J. J. Cools (Roy. Neth. Aircraft Factories Fokker), C. P. H. Hanselmann (Maschinenfabrik Augsburg-Nuernberg A.G.), and R. J. Jonke *In* NASA, Washington NASA Space Shuttle Technol. Conf. Jul. 1972 p 645-684 refs (For availability see N72-30865 21-31)
CSCL 11D

The following advanced composite materials were evaluated for future space shuttle applications: (1) Carbon and boron fiber composites using epoxy and polyimide as resins for stringer and skin panels: (2) high pressure steel tanks where the cylindrical part is reinforced by carbon fiber; and (3) an orbiter cargo door in boron fiber and polyimide resin. G.G.

N72-30887* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASSESSMENT OF ADVANCES IN STRUCTURAL ANALYSIS FOR SPACE SHUTTLE **c32**
Sidney C. Dixon, Melvin S. Anderson, and Wendell B. Stephens *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 685-725 refs (For availability see N72-30865 21-31)
CSCL 13M

The latest technology for structural analysis in relation to the design tasks that lie ahead for the space shuttle is reviewed. For shell-of-revolution structures, the analysis can be formulated as a one-dimensional problem which is readily solved by using finite-difference or numerical-integration techniques. For more general asymmetric shells, a two-dimensional formulation is required. However, the governing equations are readily formulated and are amenable to solution by finite-difference techniques. For a completely general structural arrangement, such as structural frameworks, recourse is usually made to discretized formulations using finite elements. Of course, the finite-element programs could be used for shell structures, but at a loss in accuracy and

increase in computer time compared with the special purpose programs. Author

N72-30888* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF METHODS FOR FRACTURE CONTROL OF SPACE SHUTTLE STRUCTURES
Gordon T. Smith and Robert E. Johnson *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 727-770 refs (For availability see N72-30865 21-31)
CSCL 22B

The technology with respect to fracture control requirements of the shuttle is considered. The current state-of-the-art does permit an approach based on linear elastic fracture mechanics concepts. Development and implementation of a fracture control plan should recognize deficiencies and provide adequate resources for the extensive empirical test data which are required. With respect to the cost impact of such tests, recent experiences involving advanced aircraft systems have seen unit cost increases of from 200 to 500 percent. Author

N72-30889*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NASA/DOD EARTH ORBIT SHUTTLE TRAFFIC MODELS BASED ON END TO END LOADING OF PAYLOADS
R. E. Kincade, M. E. Donahoo, and W. R. Pruett 8 Jul. 1971 97 p refs
(NASA-TM-X-68573; MSC-04491) Avail: NTIS HC $7.00 CSCL 22B

An analysis of the spacecraft configurations and space missions for the Earth Orbit Shuttle traffic model based on an end-to-end loading of payloads is presented. Two possible reusable tugs are considered. The space missions are described with respect to the following: (1) number of earth orbit shuttle flights by inclination, (2) total payloads to orbit, (3) energy stages required, and (4) characteristics of reusable tug. Author

N72-30890*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NASA/DOD EARTH ORBIT SHUTTLE TRAFFIC MODELS BASED ON SIDE BY SIDE LOADING OF PAYLOADS
R. E. Kincade, M. E. Donahoo, and W. R. Pruett 8 Jul. 1971 85 p
(NASA-TM-X-68574; MSC-04492; MSC-IN-71-FM-260) Avail: NTIS HC $6.25 CSCL 22B

An analysis of the spacecraft configurations and space missions for the Earth Orbit Shuttle traffic model based on side-by-side loading of payloads is presented. The reusable tugs to be employed for the mission are examined. The space missions are described with respect to the following: (1) number of Earth Orbit Shuttle flights by inclination, (2) total payloads to orbit, (3) energy states required, and (4) characteristics of reusable tug. Author

N72-30891*# Keuffel and Esser Co., Morristown, N.J.
FABRICATION AND EVALUATION OF A WEAK ZONE PLATE FOR MONITORING PERFORMANCE OF LARGE ORBITING TELESCOPES Final Report
Kent E. Erickson 15 Jul. 1972 61 p
(Contract NAS1-10564)
(NASA-CR-112080) Avail: NTIS HC $5.25 CSCL 22B

An experimental study of the feasibility of monitoring the optical performance of a large telescope by means of a very faint phase hologram imprinted upon the primary mirror is reported. Tests have been made using an f/5 telescope with a 0.3 m aperture. The results indicate that a usable hologram can be so faint and so restricted in area that it will probably not interfere significantly with normal operation of a 3.0 m telescope at wavelengths longer than 100 nm for stars brighter than magnitude 29. Author

N72-30892*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN APPROACH TO ATTITUDE DETERMINATION FOR A SPIN-STABILIZED SPACECRAFT (IMP 1)
Ai Chun Fang Washington Aug. 1972 31 p ref
(NASA-TN-D-6925; G-1059) Avail: NTIS HC $3.00 CSCL 22A

The analysis and the FORTRAN program are presented for the determination of attitude of a spin-stabilized spacecraft. The use of telemetry data that provide information about two reference vectors and their relation to the spin is outlined. A technique for the determination of the spin-axis orientation that employs only simple calculations is described. Author

N72-30893*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LAUNCH VEHICLE SYSTEM REQUIREMENTS AND RESTRAINTS FOR THE ERTS-A SPACECRAFT
John F. Corrigan Jul. 1971 70 p
(Proj. ERTS)
(NASA-TM-X-65983; X-430-71-305) Avail: NTIS HC $5.00 CSCL 22B

The technical requirements and restraints imposed by the ERTS spacecraft upon the Delta launch vehicle, shroud system, associated launch complex, and range are presented for technical coordination among various agencies involved in the launch vehicle and launch operations. The payload and spacecraft systems are described, and the mission, design, test, and launch base data are outlined. N.E.N.

N72-30894*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
ANALYTICAL DETERMINATION OF THE EFFECT OF STRUCTURAL ELASTICITY ON LANDING STABILITY OF A VERSION OF THE VIKING LANDER
R. M. Laurenson Washington NASA Aug. 1972 77 p refs
(Contract NAS1-8137)
(NASA-CR-112115) Avail: NTIS HC $6.00 CSCL 22B

A limited analytical investigation was conducted to assess the effects of structural elasticity on the landing stability of a version of the Viking Lander. Two landing conditions and two lander mass and inertia distributions were considered. The results of this investigation show that the stability-critical surface slopes were lower for an uphill landing than for a downhill landing. In addition, the heavy footpad mass with its corresponding inertia distribution resulted in lower stability-critical ground slopes than were obtained for the light footpad mass and its corresponding inertia distribution. Structural elasticity was observed to have a large effect on the downhill landing stability of the light footpad mass configuration but had a negligible effect on the stability of the other configuration examined. Because of the limited nature of this study, care must be exercised in drawing conclusions from these results relative to the overall stability characteristics of the Viking Lander. Author

N72-30895*# Boeing Co., Huntsville, Ala.
SATURN BASE HEATING HANDBOOK Final Report
C. R. Mullen, R. L. Bender, R. L. Bevill, J. Reardon, and L. Hartley 1 May 1972 506 p refs
(Contract NAS8-5608)
(NASA-CR-61390; TD-050) Avail: NTIS HC $27.50 CSCL 22B

A handbook containing a summary of model and flight test base heating data from the S-1, S-1B, S-4, S-1C, and S-2 stages is presented. A review of the available prediction methods is included. Experimental data are provided to make the handbook a single source of Saturn base heating data which can be used for preliminary base heating design predictions of launch vehicles. Author

N72-30896*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC-BOOM GROUND-PRESSURE MEASUREMENTS

FROM APOLLO 15
David A. Hilton, Herbert R. Henderson, and Royce McKinney Washington Sep. 1972 36 p refs
(NASA-TN-D-6950; L-8445) Avail: NTIS HC $3.00 CSCL 22C

Sonic boom pressure signatures recorded during the launch and reentry phases of the Apollo 15 mission are presented. The measurements were obtained along the vehicle ground track at 87 km and 970 km downrange from the launch site during ascent; and at 500 km, 55.6 km, and 12.9 km from the splashdown point during reentry. Tracings of the measured signatures are included along with values of the overpressure, impulse, time duration, and rise times. Also included are brief descriptions of the launch and recovery test areas in which the measurements were obtained, the sonic boom instrumentation deployment, flight profiles and operating conditions for the launch vehicle and spacecraft, surface weather information at the measuring sites, and high altitude weather information for the general measurement areas. Author

N72-30897*# Boeing Co., Seattle, Wash. Research and Engineering Div.
A THERMAL SCALE MODELING STUDY FOR APOLLO AND APOLLO APPLICATIONS, VOLUME 2 Final Report
Roger L. Shannon Jun. 1972 241 p refs
(Contract NAS9-8332)
(NASA-CR-115753; D180-15048-1-Vol-2) Avail: NTIS HC $14.25 CSCL 22B

The development and demonstration of practical thermal scale modeling techniques applicable to systems involving radiation, conduction, and convection with emphasis on cabin atmosphere/cabin wall thermal interface are discussed. The Apollo spacecraft environment is used as the model. Four possible scaling techniques were considered: (1) modified material preservation, (2) temperature preservation, (3) scaling compromises, and Nusselt number preservation. A thermal mathematical model was developed for use with the Nusselt number preservation technique. Author

N72-30898*# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENTS IN ATMOSPHERIC ELECTRICITY DESIGNED TO IMPROVE LAUNCH SAFETY DURING THE APOLLO SERIES Final Report
J. E. Nanevicz, E. T. Pierce, and A. L. Whitson Jun. 1972 87 p refs
(Contract NAS9-11357; SRI Proj. 8940)
(NASA-CR-115754) Avail: NTIS HC $6.50 CSCL 22D

Ground test measurements were made during the launches of Apollo 13 and 14 in an effort to better define the electrical characteristics of a large launch vehicle. Of particular concern was the effective electrical length of the vehicle and plume since this parameter markedly affects the likelihood of a lightning stroke being triggered by a launch during disturbed weather conditions. Since no instrumentation could be carried aboard the launch vehicle, the experiments were confined to LF radio noise and electrostatic-field measurements on the ground in the vicinity of the launch pad. The philosophy of the experiment and the instrumentation and layout are described. From the results of the experiment it is concluded that the rocket and exhaust do not produce large-scale shorting of the earth's field out to distances of thousands of feet from the launch pad. There is evidence, however, that the plume does add substantially to the electrical length of the rocket. On this basis, it was recommended that there be no relaxation of launch rules for launches during disturbed weather. Author

N72-30899*# General Dynamics/Convair, San Diego, Calif.
UMBILICAL CONNECT TECHNIQUES IMPROVEMENT-TECHNOLOGY STUDY Final Report, 1 Jul. 1971 - 2 Jun. 1972
Donald C. Valkema 2 Jun. 1972 176 p
(Contract NAS10-7702)
(NASA-CR-127816) Avail: NTIS HC $11.00 CSCL 22D

The objective of this study was to develop concepts, specifications, designs, techniques, and procedures capable of significantly reducing the time required to connect and verify umbilicals for ground services to the space shuttle. The desired goal was to reduce the current time requirement of several shifts for the Saturn 5/Apollo to an elapsed time of less than one hour to connect and verify all of the space shuttle ground service umbilicals. The study was conducted in four phases: (1) literature and hardware examination, (2) concept development, (3) concept evaluation and tradeoff analysis, and (4) selected concept design. The final product of this study was a detail design of a rise-off disconnect panel prototype test specimen for a LO2/LH2 booster (or an external oxygen/hydrogen tank for an orbiter), a detail design of a swing-arm mounted preflight umbilical carrier prototype test specimen, and a part 1 specification for the umbilical connect and verification design for the vehicles as defined in the space shuttle program. Author

N72-30900*# Ball Bros. Research Corp., Boulder, Colo.
OSO-6 ORBITING SOLAR OBSERVATORY Final Report
12 Jan. 1972 422 p refs
(Contract NAS5-9300)
(NASA-CR-122451; F70-03) Avail: NTIS HC $24.25 CSCL 22B

The description, development history, test history, and orbital performance analysis of the OSO-6 Orbiting Solar Observatory are presented. The OSO-6 Orbiting Solar Observatory was the sixth flight model of a series of scientific spacecraft designed to provide a stable platform for experiments engaged in the collection of solar and celestial radiation data. The design objective was 180 days of orbital operation. The OSO-6 has telemetered an enormous amount of very useful experiment and housekeeping data to GSFC ground stations. Observatory operation during the two-year reporting period was very successful except for some experiment instrument problems. Author

N72-30901*# Wyle Labs., Inc., Huntsville, Ala.
EVALUATION OF ACOUSTIC TESTING TECHNIQUES FOR SPACECRAFT SYSTEMS Final Report, Mar. 1970 - Feb. 1971
James A. Cockburn Jun. 1971 348 p refs
(Contract NAS5-21203)
(NASA-CR-122450; WR-71-7) Avail: NTIS HC $19.50 CSCL 22B

External acoustic environments, structural responses, noise reductions, and the internal acoustic environments have been predicted for a typical shroud/spacecraft system during lift-off and various critical stages of flight. Spacecraft responses caused by energy transmission from the shroud via mechanical and acoustic paths have been compared and the importance of the mechanical path has been evaluated. Theoretical predictions have been compared extensively with available laboratory and in-flight measurements. Equivalent laboratory acoustic fields for simulation of shroud response during the various phases of flight have been derived and compared in detail. Techniques for varying the time-space correlations of laboratory acoustic fields have been examined, together with methods for varying the time and spatial distribution of acoustic amplitudes. Possible acoustic testing configurations for shroud/spacecraft systems have been suggested and trade-off considerations have been reviewed. The problem of simulating the acoustic environments versus simulating the structural responses has been considered and techniques for testing without the shroud installed have been discussed.
Author

N72-30902*# Grumman Aerospace Corp., Bethpage, N.Y.
SPACE SHUTTLE ORBITER HEAT PIPE APPLICATIONS. VOLUME 2: FINAL REPORT Final Report
J. P. Alario and R. C. Prager Apr. 1972 381 p refs
(Contract NAS9-12034)
(NASA-CR-128498; SPR-14-Vol-2) Avail: NTIS HC $21.25 CSCL 22B

For abstract, see N72-30907.

N72-30903*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT-DETERMINED DERIVATIVES AND DYNAMIC CHARACTERISTICS FOR THE HL-10 LIFTING BODY VEHICLE AT SUBSONIC AND TRANSONIC MACH NUMBERS

Larry W. Strutz Washington Sep. 1972 78 p refs

(NASA-TN-D-6934; H-708) Avail: NTIS HC $3.00 CSCL 22C

The HL-10 lifting body stability and control derivatives were determined by using an analog-matching technique and compared with derivatives obtained from wind-tunnel results. The flight derivatives were determined as a function of angle of attack for a subsonic configuration at Mach 0.7 and for a transonic configuration at Mach 0.7, 0.9, and 1.2. At an angle of attack of 14 deg, data were obtained for a Mach number range from 0.6 to 1.4. The flight and wind-tunnel derivatives were in general agreement, with the possible exception of the longitudinal and lateral damping derivatives. Some differences were noted between the vehicle dynamic response characteristics calculated from flight-determined derivatives and those predicted by the wind-tunnel results. However, the only difference the pilots noted between the response of the vehicle in flight and the response of a simulator programed with wind-tunnel-predicted data was that the damping generally was higher in the flight vehicle. Author

N72-30904*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A GENERAL PURPOSE MANEUVER TURNS COMPUTER PROGRAM

G. I. Jaivin 15 Aug. 1972 63 p

(Contract NAS7-100)

(NASA-CR-128027; JPL-TM-33-558) Avail: NTIS HC $5.25 CSCL 22B

The theory, functional description, and operating instructions of a general purpose maneuver analysis program are described. The program computes the maneuver turns required to point a given spacecraft-fixed vector in the direction of a given inertially-fixed vector. Any two-turn maneuver sequence may be arbitrarily chosen. If it is not possible to accomplish the desired orientation with a two-turn sequence, a three-turn sequence can be specified. The coordinates of an arbitrarily selected inertially-fixed reference vector are computed before and after each turn that is performed. Two program options provide the reference vector coordinates throughout each turn at selected points and the reference vector positions before and after each turn of an arbitrarily prescribed set of maneuver turns. Author

N72-30905*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

APOLLO EXPERIENCE REPORT: LUNAR MODULE COMMUNICATIONS SYSTEM

Reinhold H. Dietz, Donald E. Rhoades, and Louis J. Davidson Washington Sep. 1972 69 p refs

(NASA-TN-D-6974; MSC-S-324) Avail: NTIS HC $3.00 CSCL 17B

The development of the lunar module communications system is traced from the initial concept to the operational system used on manned lunar missions. The problems encountered during the development, the corrective actions taken, and recommendations for similar equipment in future programs are included. The system was designed to provide communications between the lunar module and the manned space flight network, between the lunar module and the command and service module, and between the lunar module and the extravehicular crewmen. The system provided the equipment necessary for voice, telemetry, and television communications; ranging information; and various communications links. Author

N72-30906*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

REFURBISHMENT COST STUDY OF THE THERMAL PROTECTION SYSTEM OF A SPACE SHUTTLE VEHICLE, PHASE 2

D. W. Haas [1972] 24 p refs

(Contract NAS1-10990)

(NASA-CR-112123) Avail: NTIS HC $3.25 CSCL 22B

Labor costs and techniques associated with the refurbishment of representative TPS and their attach concepts suitable for space shuttle application have been identified on the basis of experimental tests. Ablative and reusable surface insulation TPS configurations were designed, fabricated, and tested on a full-scale mockup. The TPS attachment methods investigated included pi-strap, multiple mechanical fasteners, key/keyway, and direct bond concepts. Techniques for performing installation, inspection, repair and replacement of TPS components were studied by examining a variety of shop procedures. Major problem areas associated with these procedures and the designs to which they were applied were analyzed for several significant parameters such as handling, gaskets between joints, repair techniques, ablator plugs, etc. Results of time and motion studies of specific maintenance tasks, simulating operational procedures, were obtained. Using these data, refurbishment labor cost projections were generated for a representative Space Shuttle orbiter. Author

N72-30907*# Grumman Aerospace Corp., Bethpage, N.Y.

SPACE SHUTTLE ORBITER HEAT PIPE APPLICATIONS. VOLUME 1: SYNOPSIS Final Report, 6 Jul. 1971 - 30 Apr. 1972

J. P. Alario and R. C. Prager Apr. 1972 88 p refs

(Contract NAS9-12034)

(NASA-CR-128497; SPR-14-Vol-1) Avail: NTIS HC $6.50 CSCL 22B

An investigation was made to formulate and evaluate heat pipe applications for the space shuttle orbiter. Of the twenty-seven specific applications which were identified, a joint evaluation resulted in the selection of five of the most promising ones for prototype development. The formulation process is described, along with the applications which evolved. The bulk of the discussion deals with the top five applications: (1) heat pipe augmented cold rail; (2) avionics heat pipe circuit; (3) heat pipe/phase change material modular sink; (4) air-to-heat-pipe heat exchanger; and (5) heat pipe radiator for compartment temperature control. The philosophy, physical design details, and performance data are presented for each concept along with a comparison to the baseline design where applicable. A sixth application, heat pipe space radiator for waste heat rejection, was also recommended for prototype development. Author

N72-30908*# Chrysler Corp., New Orleans, La. Space Div.

SPACE SHUTTLE: HEAT TRANSFER RATE DISTRIBUTIONS ON MCDONNELL-DOUGLAS DELTA WING ORBITER DETERMINED BY PHASE-CHANGE PAINT TECHNIQUE FOR NOMINAL MACH NUMBER OF 8

R. K. Matthews (ARO, Inc.), W. R. Martindale (ARO, Inc.), and J. D. Warmbrod (NASA. Manned Space Flight Center) Jul. 1972 358 p ref Revised

(Contract NAS8-4016)

(NASA-CR-120025; DMS-DR-1207-Vol-1-Rev) Avail: NTIS HC $20.00 CSCL 22B

The results are reported of the phase-change paint tests conducted at Mach 8, to determine the aerodynamic heat transfer distributions on the McDonnell Douglas delta wing orbiter. Model details, test conditions, and reduced heat transfer data are presented. F.O.S.

N72-30909*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

PRELIMINARY HANDLING QUALITIES REQUIREMENTS FOR LIFTING RE-ENTRY VEHICLES DURING TERMINAL FLIGHT

Dante A. Difranco and John F. Mitchell Wright-Patterson AFB, Ohio AFFDL Aug. 1971 242 p refs Sponsored in parts by NASA

(Contract F33615-70-C-1755)

(NASA-CR-127344; AD-731563; BM-2995-F-1; AFFDL-TR-71-64) Avail: NTIS HC $14.25 CSCL 22B

Preliminary handling qualities requirements for lifting reentry vehicles during terminal flight at low supersonic, transonic, and subsonic speeds are presented and discussed. A preliminary draft of a flying qualities specification for piloted reentry vehicles is included, along with the rationale and backup data upon which the flying qualities requirements are based. Many of the requirements were adapted from, or are similar to, the requirements for piloted airplanes presented in the latest revision of the flying qualities specification for military airplanes. Comparison of flying qualities requirements of lifting reentry vehicles and airplanes is facilitated. Author

N72-30910# Sandia Labs., Albuquerque, N.Mex.
ARCTIC RECOVERY
K. H. Cordes Jan. 1972 10 p refs Sponsored by AEC
(SC-DR-710914) Avail: NTIS

Different environmental conditions encountered in the Arctic make the recovery of sounding rocket payloads a considerably different operation there from similar search-and-recovery activities in tropical or middle latitudes. Suggestions on how the operation can be improved are based on the recovery of three payloads from the Yukon Valley in March 1971. Author

N72-30911# Fiat S.p.A., Turin (Italy).
A STUDY OF THE CONTROL AND STABILISATION ASPECTS OF AN ADVANCED TELECOMMUNICATIONS SATELLITE WITH FLEXIBLE ANTENNAE AND SOLAR ARRAYS
R. DiLorenzo, T. Borelli, G. C. Ferrero, G. Fiorina, G. C. Franzini, M. Gamba, F. Marra, and D. Sciacovelli Paris ESRO May 1972 511 p refs
(Contract ESTEC-1231/71)
(ESRO-CR-60) Avail: NTIS HC $27.75

The control and stabilization problems of a telecommunications satellite with flexible parts are studied with particular attention to the application of modern control system techniques involving on-board digital computers. A mathematical model of the flexible solar arrays is developed using a one-mode, lumped-parameter model. Several alternative control systems are covered, including reaction wheels, control moment gyros, and fixed and gimballed flywheels. A survey of sensors is made for measuring both main body attitude and array motion. Also, a sun-pointing control system for the solar arrays is given.
Author (ESRO)

N72-30912# European Space Operations Center, Darmstadt (West Germany).
NETWORK/CONTROL CENTRE OPERATIONS SUMMARY OF THE TD1A MISSION (FROM F-30 DAYS TO START OF ROUTINE PHASE)
Jun. 1972 257 p
Avail: NTIS HC $15.00

A brief introduction to the TD-1A mission and an outline of the plans for ensuring satisfactory mission support are given followed by an account of the F-30 days activities, which include testing, simulation and equipment status. The countdown and launch sequences are presented together with the early orbit phase, noting, in particular, the spacecraft command evaluation and operations. The spacecraft systems operations are also included and cover the power supply, telecommunication and attitude control systems, as well as thermal behavior. ESRO

N72-30913# European Space Operations Center, Darmstadt (West Germany).
NETWORK/CONTROL CENTRE OPERATIONS SUMMARY OF THE TD1A MISSION (FROM F-30 DAYS TO START OF ROUTINE PHASE), APPENDIX
Jun. 1972 217 p
Avail: NTIS HC $13.00

Representative computer generated plots of TD-1 satellite performance are presented for the first 11 orbits for the power and telecommunications subsystems. ESRO

N72-30914# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
AN AUTOMATIC, CONTINUOUSLY VARIABLE GAIN CONTROLLER FOR THE LANCE DIRECTIONAL CONTROL ELECTRONICS
Pat H. McIngvale Feb. 1972 42 p
(DA Proj. 1X2-22251-D-231)
(AD-742215; RG-TR-72-5) Avail: NTIS CSCL 16/4

A desire to increase accuracy of the LANCE directional control system (in the presence of variable crosswinds) prompted an investigation into methods of applying a continuous time varying gain controller to the directional control electronics. A function generator was designed whose output voltage reproduced the time varying characteristic of nominal static margin. With this function generator as the driving source, three variable gain amplifiers were designed that utilized three different concepts. A preliminary design of a dual-band function generator to allow for either a light or a heavy warhead was considered. A firm design of this is not possible until more simulations (using the heavy warhead) are performed. Preliminary consideration was given to the increased components required to implement the continuously variable gain controller and the problem of packaging it in the present directional control system. It appears feasible that the variable gain controller can be packaged in the required space using presently available technology.
Author (GRA)

N72-30915# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
DEVELOPMENT OF A TRANSPONDERSONDE FOR THE SUPER-LOKI METEOROLOGICAL ROCKET
Elefterios J. Georgian and Jack R. Griffin 2 Feb. 1972 28 p refs
(AF Proj. 6670)
(AD-740954; AFCRL-72-0089; IP-174) Avail: NTIS CSCL 19/7

The report discusses the results of an in-house AFCRL effort to design and develop a meteorological transponder rocketsonde. The rocketsonde was designed to be flown in the Super-LOKI rocket vehicle to an apogee altitude of about 75 km where it is ejected and descends on a STARUTE, or stable parachute, while transmitting meteorological data. It is tracked by an automatic ground tracking station, Rawin Set AN/GMD-4, which demodulates the signals transmitted by the sonde to provide direct measurement of atmospheric temperatures, elevation and azimuth angles, and slant range. The angles and slant range are then used to compute wind velocity and the altitudes to which temperature and winds are assigned. It is this independent slant range measuring capability which distinguishes the transpondersonde from other types of rocketsondes, in that high precision radars are not necessary to obtain the wind and altitude data as is necessary with the nontransponder systems. As a result, meteorological rocket soundings can now be conducted in areas of the world where tracking radars are not available or cannot be suitably scheduled. Author (GRA)

N72-30916# Lowell Technological Inst. Research Foundation, Mass.
DESIGN AND FABRICATION OF SOUNDING ROCKET PAYLOADS Interim Report, Feb. 1971 - Jan. 1972
Richard E. Kenyon Mar. 1972 38 p
(Contract F19628-70-C-0149; AF Proj. 8692)
(AD-740952; LTIRF-343/SE; SR-2) Avail: NTIS CSCL 19/7

An ongoing effort has been maintained from February 1971 through January 1972 providing engineering design, fabrication, test and field support services concerned with various sounding rocket payloads. A concise summary of the details relative to each payload is given in the form of a one page synopsis. Other sections of this report present information describing newly implemented monitor circuit designs and a simplified method of determining the magnitude of weights for despin mechanisms. A new design of a Marmon joint clamp and results of bend tests are discussed. Author (GRA)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N72-30917*# Cincinnati Univ., Ohio.
DYNAMIC CHARACTERISTICS OF A TWO-STAGE VARIABLE-MASS FLEXIBLE MISSILE WITH INTERNAL FLOW
Leonard Meirovitch (Virginia Polytechnic Inst.) and John Bankovskis Washington NASA Jun. 1972 138 p refs
(Grant NGR-36-004-030)
(NASA-CR-2076) Avail: NTIS HC $3.00 CSCL 16D

A general formulation of the dynamical problems associated with powered flight of a two stage flexible, variable-mass missile with internal flow, discrete masses, and aerodynamic forces is presented. The formulation comprises six ordinary differential equations for the rigid body motion, 3n ordinary differential equations for the n discrete masses and three partial differential equations with the appropriate boundary conditions for the elastic motion. This set of equations is modified to represent a single stage flexible, variable-mass missile with internal flow and aerodynamic forces. The rigid-body motion consists then of three translations and three rotations, whereas the elastic motion is defined by one longitudinal and two flexural displacements, the latter about two orthogonal transverse axes. The differential equations are nonlinear and, in addition, they possess time-dependent coefficients due to the mass variation. Author

N72-30918*# Cornell Univ., Ithaca, N.Y.
A METHOD OF LIMIT POINT CALCULATION IN FINITE ELEMENT STRUCTURAL ANALYSIS
R. H. Gallagher and S. T. Mau Washington NASA Sep. 1972 30 p refs
(Grant NGL-33-010-070)
(NASA-CR-2115) Avail: NTIS HC $3.00 CSCL 13M

An approach is presented for the calculation of limit points for structures described by discrete coordinates, and whose governing equations derive from finite element concepts. The nonlinear load-displacement path of the imperfect structure is first traced by use of a direct iteration scheme and the determinant of the governing algebraic equations is calculated at each solution point. The limit point is then established by extrapolation and imposition of the condition of zero slope of the plot of load vs. determinant. Three problems are solved in illustration of the approach and in comparison with alternative procedures and test data. Author

N72-30919*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATION AND AERODYNAMIC BUCKLING EXPERIMENTS FOR BLUNT TRUNCATED CONICAL SHELLS WITH RING-SUPPORTED EDGES
Robert Miserentino and Sidney C. Dixon Washington Sep. 1972 34 p refs
(NASA-TN-D-6864; L-8185) Avail: NTIS HC $3.00 CSCL 13M

The vibration and buckling characteristics of a series of 140 deg ring-supported conical shells have been investigated experimentally and analytically. Experimental results were obtained from 14 conical shells, each attached to a solid nose cap at the small end. The large (base) end was either free or attached to a solid ring of rectangular cross section. The size of the solid base rings of rectangular cross section was systematically varied to provide a wide range of edge restraint. Shell buckling was induced by aerodynamic loading at a Mach number of 3; the vibration data were obtained prior to the wind tunnel tests. The experimental vibration data indicated that the size of the base rings had a pronounced effect on the magnitude of the frequencies and on the frequency spectrum. For vibration modes having less than two circumferential waves, the frequencies descreased with increasing ring size; whereas, for modes with several circumferential waves, the frequencies initially increased rapidly with ring size and then became relatively insensitive to further increases in ring size. This latter behavior was similar to the trend exhibited by the variation of buckling pressure with ring size. The experimental results were in excellent qualitative agreement with theoretical results and indicated that current shell-of-revolution analyses are adequate for predicting the vibration and buckling behavior of ring-supported shells, at least for the simple isotropic shells considered in this investigation. Author

N72-30920# Lockheed Missiles and Space Co., Palo Alto, Calif.
SYNTHESIS OF OPTIMAL CYLINDRICAL, BONDED PLASTIC SHELLS UNDER AXIAL COMPRESSION AND EXTERNAL PRESSURE
R. B. Rikards, G. A. Teters, and I. K. Tsypinas [1972] 10 p refs Transl. into ENGLISH from Mech. Polim. (USSR), no. 2, 1972 p 301-309
Avail: NTIS HC #3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The synthesis of anisotropic, cylindrical, minimum weight shells is considered. The characteristics of the bonding fibers and the binder are presented as initial data. The method of projective gradients was used to perform the optimization. Author

N72-30921*# Southwest Research Inst., San Antonio, Tex.
DEFORMATION MECHANICS OF DEEP SURFACE FLAW CRACKS Final Report
P. H. Francis, A. Nagy, and R. E. Beissner Jul. 1972 158 p refs
(Contract NAS9-12012)
(NASA-CR-128514) Avail: NTIS HC $10.00 CSCL 20K

A combined analytical and experimental program was conducted to determine the deformation characteristics of deep surface cracks in Mode I loading. An approximate plane finite element analysis was performed to make a parameter study on the influence of crack depth, crack geometry, and stress level on plastic zones, crack opening displacement, and back surface dimpling in Fe-3Si steel and 2219-T87 aluminum. Surface replication and profiling techniques were used to examine back surface dimple configurations in 2219-T87 aluminum. Interferometry and holography were used to evaluate the potential of various optical techniques to detect small surface dimples on large surface areas. Author

N72-30922*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE CRACK GROWTH FROM A CIRCULAR HOLE WITH AND WITHOUT HIGH PRIOR LOADING
John H. Crews, Jr. and N. H. White Washington Sep. 1972 34 p refs
(NASA-TN-D-6899; L-8305) Avail: NTIS HC $3.00 CSCL 20K

Fatigue crack growth from a circular hole was investigated experimentally and analytically. An aluminum-alloy sheet specimen was cycled under a single level of loading with and without prior high loads. Tests showed that the crack propagation life was significantly longer when the high loads were applied initially. This longer life was attributed to compressive residual stresses produced near the hole by the initial high loads. The residual stresses near the hole were determined by an elastoplastic analysis and were then used to develop a stress-intensity solution for a crack growing through the residual stress field. This solution and a similar solution for the case of no prior loading were used to predict crack growth. The predicted crack growth agreed closely with the experimental values. Author

N72-30923# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
A STUDY OF STRESSES AND DEFORMATIONS IN

SANDWICH PLATES WITH ANISOTROPIC FACINGS
Walter P. Stroud, Jr. and Herbert B. Kingsbury 27 Jan. 1972 32 p refs Backup document for AIAA synoptic scheduled for publication in Journal of Aircraft, Dec. 1972
Avail: NTIS HC $3.75

The stresses and defcrmations in a sandwich plate with generally orthotropic facings and an isotropic core subjected to a uniform static lateral load are discussed. A numerical study of the effect of facing anisotropy on the stress and strain components and on the core and facing strain energies is carried out. It is shown how the introduction of facing anisotropy affects both the magnitude and distribution of stresses and strains and how the relative values of core and facing strain energies may be widely altered by varying the elastic axes of the facing material. Author

N72-30924# Battelle Memorial Inst., Columbus, Ohio.
LOW CYCLE FATIGUE AND CREEP FATIGUE OF INCOLOY ALLOY 800
Carl E. Jaske, Harold Mindlin, and James S. Perrin Feb. 1972 56 p refs
(Contract W-7405-eng-92)
(BMI-1921) Avail: NTIS

The low-cycle fatigue behavior of solution-annealed Incoloy alloy 800 was studied over the temperature range of 70 to 1400 F, with primary emphasis placed upon temperatures between 1000 and 1400 F. Creep rupture tests conducted at 1400 F and creep-rupture data obtained from several other laboratories were analyzed to develop stress rupture curves between 1000 and 1500 F. The heat-to-heat variation in fatigue life among four heats of material was found to be negligible for continuous cycling, and best-fit curves for total strain range versus fatigue were developed at 70, 800, 1000, 1200, and 1400 F. Using the incremental step test, cyclic stress-strain curves were developed at the same temperatures. Author (NSA)

N72-30925# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
COMPUTATION OF THE VIBRATIONAL CHARACTERISTICS OF A SATELLITE STRUCTURE M.S. Thesis - Paris Univ. [CALCUL DES CARACTERISTIQUES VIBRATOIRES D'UNE STRUCTURE DE SATELLITE]
Daniel Engrand 1972 48 p refs In FRENCH; ENGLISH summary
(ONERA-NT-188) Avail: NTIS HC $4.50

A prediction technique for the analysis of the dynamic behavior of satellite structures is presented. It is shown that geometrical and mechanical symmetries of the structure make it possible to divide the eigen mode computation problem into four simpler problems. The computation is made by means of a general discrete Ritz method, which is not fundamentally different from usual finite element displacement methods but more adapted to the particular difficulties inherent in the structure. A comparison was made of results obtained using the Ritz method with experimental laboratory results and good agreement was found for the first six eigen modes. ESRO

N72-30926# Max-Planck-Institut fuer Stromungsforschung, Gottingen (West Germany).
DERIVATION OF THE CLASSICAL THEORETICAL ELASTICITY PLATE EQUATION BY SYSTEMATIC THICKNESS PARAMETER EXPANSION Thesis - Goettingen Univ. [HERLEITUNG DER PLATTENGLEICHUNG DER KLASSISCHEN ELASTIZITAETSTHEORIE DURCH SYSTEMATISCHE ENTWICKLUNG NACH EINEM DICKENPARAMETER]
Klaus Brod 1972 60 p refs In GERMAN
(Rept-2/1972) Avail: NTIS HC $5.00

Elastic plate bending differential equations for top and bottom random loading are derived using two approximation methods. Firstly, a direct method is demonstrated, in which the boundary conditions on the top and bottom are developed using the parameter h, the half plate thickness divided by a characteristic length. Secondly, calculus of variations is used for approximation. For both methods the linear infinitesimal elasticity theory is employed and the result contains the known plate equations as the lowest approximation. ESRO

N72-30927# National Physical Lab., Teddington (England). Div. of Inorganic and Metallic Structure.
A 25 kbar PISTON-CYLINDER APPARATUS: CONSTRUCTION AND OPERATING TECHNIQUES
H. S. Turner, W. F. Wall, S. L. Thomas, and W. R. D. Manning Jun. 1972 153 p refs
(NPL-IMS-16) Avail: NTIS HC $9.75

The development and operation of vessels for the conduct of organic reactions in the liquid phase at high pressure are described. The steel piston-cylinder device chosen operates within a pressure of 40 kb with a compressed working volume of at least 10 ml, under purely hydrostatic conditions and is able to accomodate volume changes of up to 50%. ESRO

N72-30928# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
POSTBUCKLING CALCULATION FOR AN INFINITELY LONG ISOTROPIC CIRCULAR CYLINDER [NACHBEULRECHNUNG FUER EINEN UNENDLICH LANGEN ISOTROPEN KREISZYLINDER]
Maria Esslinger Jun. 1972 43 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-37) Avail: NTIS HC $4.25; DFVLR, Porz 12 DM

High-speed motion pictures have revealed Karman's diamond shaped postbuckling pattern to exist in the unstable postbuckling region. Postbuckling calculations based on Karman's pattern were performed in order to find a lower limit of the buckling loads of imperfect cylinders. As criterion for this lower limit, only the value of axial shortening was used. A relative minimum of shortening at the postbuckling pattern, could be observed in the motion pictures. Author (ESRO)

N72-30929# Systems Science and Software, La Jolla, Calif.
A RATE-DEPENDENT CONSTITUTIVE MODEL OF SHOCK-LOADED S-200 BERYLLIUM Final Report, 14 Aug. 1971 - 15 Jan. 1972
Harold E. Read and Robert A. Cecil Apr. 1972 89 p refs
(Contract DASA01-70-C-0055)
(AD-742143; Rept-3SR-949; DNA-2845F) Avail: NTIS CSCL 11/6

A rate-dependent constitutive model is developed for the one-dimensional deformation of S-200 beryllium at room temperature. The current knowledge of dislocation dynamics is used in formulating the constitutive model from consideration of the basic physical mechanisms that are involved in plastic flow processes. The constants which arise in the model are evaluated from macroscopic data, including quasi-static strain hardening data, low-to-medium strain rate data, and stress wave profiles. A numerical scheme for incorporating this constitutive model into one-dimensional, finite-difference computer codes has been developed and implemented into the RIP code. Calculations of the attenuation of thin stress pulses show excellent agreement with experimental observations. Author (GRA)

N72-30930# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
SERIES REPRESENTATION OF AN IDEALIZED BUCKLE PATTERN OF A COMPRESSED CIRCULAR CYLINDRICAL SHELL OF FINITE LENGTH Interim Report
Elfriede Tungl and Nicholas Hoff, J. Oct. 1971 64 p refs
(Contract F44620-69-C-0009; AF Proj. 9782)
(AD-741843; SUDAAR-429; AFOSR-71-2992TR) Avail: NTIS CSCL 20/11

The actually observed buckle pattern of a thin-walled circular cylindrical shell is idealized to an inextensional pattern with sharp creases. This pattern is represented by an infinite double series containing trigonometric functions in the

circumferential direction. For the axial direction more suitable sets of functions are found with the aid of Gegenbauer polynomials. Author (GRA)

N72-30931# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

FRACTURE MECHANICS FOR AN INTERFACIAL CRACK BETWEEN ADHESIVELY BONDED DISSIMILAR MATERIALS

Charles Yi-jer Wang Mar. 1972 101 p refs

(Contract N00019-72-C-0274; N00019-71-C-0323)

(AD-742124; T/AM-353; UILU-ENG-72-6001) Avail: NTIS CSCL 13/5

A plate composed of two dissimilar materials, bonded together along a straight line with a center crack was studied. The problem represents an idealization of an adhesive joint or a composite structure with an interfacial flaw or crack caused by faulty joining technique. Common examples are imperfections, voids, or broken bonds on the composite interface. Combined with the finite element technique, the strain energy method and the J-integral method have been extended to a bi-material problem to calculate the value of the strain energy rate. A general relationship between strain energy rate and total stress intensity factor is then derived using the crack closure technique. The ratio of stress intensity factors was also examined. The numerical analysis concentrated on three categories of composite materials with moduli ratio E sub 2/E sub 1 = 1, 20,and 120. These results provide a complete crack-up stress analysis and are needed for the study and understanding of the fracture mechanics of bi-material problems. Author (GRA)

N72-30932# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

EFFECT OF DYNAMICALLY INDUCED RADIAL-DISPLACEMENT PERTURBATIONS ON THE MAXIMUM STRENGTH OF INITIALLY IMPERFECT, CIRCULAR CYLINDRICAL SHELLS UNDER CONSTANT-RATE END SHORTENING Final Technical Report

Joseph Mullen, Jr. and Jean Mayers Feb. 1972 75 p refs

(Contract DAAJ02-70-C-0075; DA Proj. 1F0-61102-A-33F)

(AD-741777; USAAMRDL-TR-71-71) Avail: NTIS CSCL 20/11

The effects of dynamic perturbations on the maximum strength of initially imperfect, axially compressed, circular cylindrical shells are studied using a modified Hamilton's principle based on a Reissner-type functional, von Karman-Donnell shell kinematics, and a deformation theory of plasticity. The dynamic effects have been included by making use of the analogy of time-dependent imperfection growth to represent dynamic disturbance of the lateral motion of the shell wall. The results of the present analysis reflect families of load versus end-shortening curves for long circular cylinders. For each material, initial imperfection parameter, and radius-to-wall thickness ratio, there exist frequency-shortening rate ratios which provide unique load-end shortening paths in both the elastic and inelastic ranges. Significant maximum strength reductions are obtained for aluminum and stainless steel relative to the predictions of static elastic and inelastic theoretical analyses for shell radius-to-thickness ratios representative of closely stiffened and sandwich construction. Author (GRA)

N72-30933# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

FINITE AXISYMMETRIC DEFORMATIONS OF ELASTIC MEMBRANES

A. D. Kydoniefs Apr. 1972 19 p refs

(Contract N00014-67-A-0370-0001)

(AD-742088; CAM-100-15) Avail: NTIS CSCL 20/11

The authors consider the axisymmetric deformations due to edge tractions and internal pressure of an elastic membrane composed of a homogeneous, incompressible and isotropic material possessing a strain-energy function. For a given initial thickness the undeformed membrane is determined in terms of the deformed configuration. The solution given to this inverse problem is exact and valid for a general strain-energy function. For the particular case of a neo-Hookean material an explicit solution is given. The theory is illustrated by its application to the specific example of the deformation of a membrane, under edge tractions, into a truncated conic surface. Author (GRA)

N72-30934# Army Foreign Science and Technology Center, Charlottesville, Va.

FLUCTUATIONS IN MECHANICAL SYSTEMS DUE TO THE IMPERFECT ELASTICITY OF MATERIALS

Georgii Stepanovich Pisarenko 12 Jan. 1972 418 p refs Transl. into ENGLISH from the book "Kolebaniya Mekhonicheskikh Sistem a Uchetom Nesovershennoi Uprugosti Materiala" Kiev, 1970 p 1-393

(AD-741715; FSTC-HT-23-515-72) Avail: NTIS CSCL 20/11

The report deals with problems related to calculation of vibrations of elastic systems with allowance for imperfect elasticity of materials. Methods of describing inelastic couplings are presented, along with techniques of investigating energy dissipation during vibrations of mechanical systems, as well as the results of experimental studies of energy dissipation in different materials with allowance for numerous factors over a wide range of amplitudes of cyclic stresses. Author (GRA)

N72-30935# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF INTEGRAL EQUATIONS TO THE PROBLEM OF STABILITY OF CYLINDRICAL SHELLS REINFORCED BY CIRCULAR RIBBING IN NONUNIFORM STRESS CONDITIONS

I. S. Malyutin 7 Mar. 1972 11 p refs Transl. into ENGLISH from Trans. of 7th All Union Conf. on Theory of Sheathing and Laminates (USSR), 1970 p 397-402

(AD-742370; FTD-HC-23-1802-71) Avail: NTIS CSCL 20/11

The author discusses the stability of a reinforced cylindrical shell under hoop and axial stresses that are variable along the generatrices, while considering the discrete nature of the arrangement of the ribs. In the general case, the ribs: arrangement is arbitrary, while their rigidity and the forces in them are not uniform. The problem reduces to finding the proper value of a uniform integral equation. In the case where hoop stresses are present, the integral equation is transformed into a symmetric one. The nuclei that the author determines for the discussed stability equations are examined in a concrete problem.

Author (GRA)

N72-30936# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.

AEROELASTIC STABILITY OF THIN SHELL STRUCTURES AT SUBSONIC MACH NUMBERS AND THE ACTIVE SUPPRESSION OF FLUTTER PHENOMENA Final Report, 1 Dec. 1970 - 30 Nov. 1971

Ronald O. Stearman Jan. 1972 31 p refs

(Grant AF-AFOSR-1998-71; AF Proj. 9782)

(AD-741899; AFOSR-72-1010TR) Avail: NTIS CSCL 20/11

Experimental and theoretical research on aeroelastic stability and response problems has been carried out this past year in several areas. A major portion of the research centered around an investigation on the stability of thin cylindrical shell structures subjected to a subsonic compressible flow environment. Other studies were concerned with the active suppression of interfering lifting surface flutter phenomenon and the active control of rapid transit system response for improving ride quality. Studies were also conducted on the suppression of stall and stall flutter phenomenon. A brief description of this research is presented herein. GRA

N72-30937# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.

FORCED PLANE VIBRATION OF A MOVING THREADLINE Ph.D. Thesis

Alfred J. Unione Apr. 1972 147 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-741897; THEMIS-UI-41) Avail: NTIS CSCL 20/11

The plane response of a moving threadline under forced excitation is studied experimentally and theoretically. Instabilities in the first mode vibration are produced for a variety of initial conditions. The axial velocity of instability is observed to be dependent on one dimensionless coefficient, labeled Tr. Tr is found from a dimensional analysis, and also appears in the non-dimensionalization of the basic equations of motion for a moving threadline. Analytically, a system of ordinary differential equations are developed from the basic partial differential equations, by applying a weighted residual method. The ordinary system is solved numerically, and the solutions are periodic for a range of axial velocity. The velocity where periodic solutions break down is found to be dependent on Tr, verifying the experimental results. Author (GRA)

N72-30938# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESSED STATE OF A CONICAL SANDWICH SHELL UNDER EXTERNAL PRESSURE
N. K. Galimov and G. V. Zakirov 7 Mar. 1972 8 p Transl. into ENGLISH from Trans. of 7th All Union on the Theory of Shells and Plates (USSR), 1970 p 635-655
(AD-742369; FTD-HC-23-1799-71) Avail: NTIS CSCL 20/11

The article is devoted to the determination of the axially-symmetric stressed state of a round conical sandwich shell with dully fastened edges, when it is under external pressure. The author presents a system of equilibrium equations for a sandwich shell under stress and gives the relationships between stresses and motions. GRA

N72-30939# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
THERMAL BUCKLING OF A CONSTRAINED ELASTIC RING
Lotfi El-Bayoumy Aug. 1971 39 p refs
(Grant AF-AFOSR-1990-71; AF Proj. 9782)
(AD-741906; NYU-AA-71-27; AFOSR-71-2436TR) Avail: NTIS CSCL 20/11

The buckling problem of a heated circular elastic ring confined to a uniformly contracting circular boundary is investigated. The buckled configuration is assumed to consist of a shallow detached region with the remainder of the ring in contact with the contracting boundary. The ring is treated as a variational problem with variable end points, by virtue of which, a transversality condition is obtained for the determination of the extent of the detached region. The influence of temperature variation and level of prestressing on the buckling phenomena are studied and a correspondence relationship between the pure contraction and thermal problems is obtained. Author (GRA)

N72-30940# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
ON THE BUCKLING AND POSTBUCKLING OF CIRCULAR ARCHES AND RINGS Interim Report
Dym L. Clive Aug. 1971 38 p refs Supported in part by Carnegie-Mellon Univ.
(Contract F61052-69-C-0040)
(AD-741849; TAE-133; SR-5) Avail: NTIS CSCL 20/11

The report treats the buckling and postbuckling behavior of circular arches and rings under constant directional pressure. New exact and approximate solutions are given for the linearized eigenvalue problem. It is clearly demonstrated that the assumption of inextensibility is quite reasonable for the asymmetric buckling of steeper arches and of rings. Asymptotic analyses of early postbuckling behavior are given, based on the theory of Koiter and the formalism of Budiansky and Hutchinson. The postbuckling behavior is shown to be stable, and unaffected by the assumption of inextensibility. Author (GRA)

N72-30941# J. G. Engineering Research Associates, Baltimore, Md.
IMPULSIVE RESPONSE OF A STIFFENED PLATE MASS LOADED AROUND THE EDGES Final Report
Joshua E. Greenspon Jan. 1972 78 p refs
(Contract N000167-71-C-0024)
(AD-742086) Avail: NTIS CSCL 13/10

The report develops the solution for a cross stiffened plate with mass leading around the edges subject to in impusive loading. Orthotropic plate theory is used to model the stiffened plate. Two solutions are obtained. The first is based upon mode approximations using products of beam functions with edge mass and inertia to represent the modes. The second solution is a finite difference solution. Computer programs and numerical results are given for the first solution. All the necessary equations are set up for the second solution in order to carry out either a modal analysis or a differential equation analysis of a 25 element cross stiffened plate with variable mass and stiffness properties. Author (GRA)

N72-30942# Pennsylvania State Univ., University Park. Ordnance Research Lab.
TRANSVERSE VIBRATION OF UNIFORM AND NONUNIFORM INTERNALLY DAMPED CANTILEVER BEAMS Ph.D. Thesis
Roger L. Kerlin 13 Mar. 1972 204 p refs
(Contract N00017-70-C-1407)
(AD-742110; TM-72-37) Avail: NTIS CSCL 13/13

The driving-point impedances and transmissibilities of uniform cantilever beams in transverse vibration have been measured experimentally. Although the impedances were recorded with a commercial impedance head, the experimental procedures developed permitted measurements to be made through a far greater dynamic range than reported hitherto. The measured impedances of metal alloy beams compare closely with the predictions of theory. The transmissibility of an aluminum beam has been measured in three reciprocal experiments that successfully substantiated the theoretical prediction that extensive regions of attenuation occur in the transmissibility of a beam when it is driven by identical but suitably located dual forces, when it is mass loaded at a point intermediate to these dual forces, and when these forces originate from resilient mountings that support a force-excited mass. Author (GRA)

N72-30943# Virginia Polytechnic Inst., Blacksburg. Coll. of Engineering.
YIELD ZONES IN POLYMERIC AND METALLIC PLATES UNDER PURE BENDING CONTAINING A THROUGH CRACK
H. F. Brinson, J. H. Underwood (Benet Res. and Eng. Labs.), and A. R. Rosenfield (Battelle Mem. Inst.) Apr. 1972 34 p refs
(Contract DAAF07-70-C-0444)
(AD-742091; VPI-E-72-7) Avail: NTIS CSCL 20/11

The Dugdale strip yielding model is extended to include plates under pure bending utilizing a superposition of stress intensity factors. Experiments on polycarbonate, mild steel and silicon iron are reported which validate the extended model. In the analysis both 4th and 6th order plate theories are considered. It is demonstrated that the 6th order theory gives the same results as an earlier solution obtained on the basis of stress functions developed from 4th order theory due to a peculiarity of the earlier solution. The effects of crack closure, not accounted for in the model, are discussed in relation to the agreement between analytical and experimental efforts. Author (GRA)

N72-30944# North Carolina State Univ., Raleigh. Applied Mathematics Research Group.
THE DISTRIBUTION OF STRESS NEAR THE TIP OF A CRACK WHICH ORIGINATES AT THE EDGE OF A CIRCULAR HOLE
John Tweed 28 Mar. 1972 17 p refs
(Grant AF-AFOSR-1779-69)
(AD-740613; AFOSR-72-0854TR) Avail: NTIS CSCL 20/11

The author makes use of a recent development in the theory of Mellin transforms to show that the stress intensity factor and the crack energy of a crack, which originates at the edge of a circular hole in an infinite elastic solid, are related in a simple fashion to the solution of a Fredholm integral equation of the second kind. Author (GRA)

N72-30887* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASSESSMENT OF ADVANCES IN STRUCTURAL ANALYSIS FOR SPACE SHUTTLE
Sidney C. Dixon, Melvin S. Anderson, and Wendell B. Stephens *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 685-725 refs (For availability see N72-30865 21-31)
CSCL 13M

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N72-30945*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
INVESTIGATION OF CRITICAL BURNING OF FUEL DROPLETS Semiannual Report, 1 Jan. - 30 Jun. 1972
C. B. Allison and G. S. Canada 30 Jun. 1972 24 p refs
(Grant NSR-39-009-077)
(NASA-CR-127818) Avail: NTIS HC $3.25 CSCL 21B

Fuel droplets were simulated by porous spheres having diameters in the range 0.63 to 1.9 cm and combustion tests were conducted at pressures up to 78 atm in a quiescent cold air environment. Measurements were made of the burning rate and liquid surface temperature during steady combustion. A high pressure flat flame burner apparatus is under development in order to allow testing of high pressure droplet burning in a combustion gas environment. Work was continued on the high pressure strand combustion characteristics of liquid fuels, with the major emphasis on hydrazine. Data was obtained on the burning rate and liquid surface temperatures at pressures in the range 7 to 500 psia. The response of a burning liquid monopropellant to imposed pressure oscillations is being investigated. Author

N72-30946*# North American Rockwell Corp., Downey, Calif. Space Div.
LOW-COST FABRICATION AND DIRECT BOND INSTALLATION OF FLAT, SINGLE-CURVATURE AND COMPOUND-CURVATURE ABLATIVE HEAT SHIELD PANELS
L. B. Norwood Jun. 1972 81 p refs
(Contract NAS1-10708)
(NASA-CR-112109; SD-72-SH-0086) Avail: NTIS HC $6.25 CSCL 20M

Procedures for low cost fabrication and direct bond installation of flat, single curved, and compound curvature ablative heat shields on a DC-3 aircraft are discussed. The panel sizes and attachment locations are identified. In addition to the bonding of the four contoured panels, two flat panels were bonded to the nearly flat, lower surface of the center wing section. The detailed requirements and objectives of the investigation are described. Author

N72-30947*# Martin Marietta Corp., Denver, Colo. Manufacturing Engineering Dept.
BERYLLIUM HEAT SHIELD TECHNOLOGY IN THE AREA OF THERMAL PROTECTION DEVICES Final Report
Alan E. Muhl and E. J. Rupert Jun. 1972 166 p refs
(Contract NAS8-27016)
(NASA-CR-123756; MCR-72-158; AMT-Lab-72-6-1) Avail: NTIS HC $10.50 CSCL 20M

For future space applications, it is important that thermal protection systems be reusable for space shuttle flights. Beryllium offers a unique combination of properties for use as a heat shield material (stiffness, lightweight, ability to absorb heat). In order to adequately test these properties, it was necessary to fabricate heat shields. The concept used was a two-section test panel 99.1 x 99.1 cm (39 x 39 inch) with each section made of two 0.051 cm (0.020 inch) thick beryllium corrugations brazed together as a mirror image, with titanium (Ti-6Al-4V) used as standoffs to support the panel structure. The work prior to fabrication included brazability of both beryllium and titanium, forming of beryllium and titanium, machining processes involving beryllium and chem-milling beryllium. Sub-scale samples were made of all details before actual fabrication of the large panel. The full scale test panel was hot-formed at 950 K, chem-milled to 0.041 + or - 0.005 cm (0.016 + or - 0.002 inches), trimmed, vacuum brazed, drilled and assembled. Author

N72-30948*# General Dynamics/Convair, San Diego, Calif. Aerospace Div.
EVALUATION OF COATED COLUMBIAN ALLOY HEAT SHIELDS FOR SPACE SHUTTLE THERMAL PROTECTION SYSTEM APPLICATION. VOLUME 1: PHASE 1 - ENVIRONMENTAL CRITERIA AND MATERIAL CHARACTERIZATION, OCTOBER 1970 - MARCH 1972
W. E. Black et al Jun. 1972 325 p refs
(Contract NAS1-9793)
(NASA-CR-112119) Avail: NTIS HC $18.25 CSCL 22B

The studies presented are directed toward establishing criteria for a niobium alloy thermal protection system for the space shuttle. Evaluation of three niobium alloys and two silicon coatings for heat shield configurations culminated in the selection of two coating/substrate combinations for environmental criteria and material characterization tests. Specimens were exposed to boost and reentry temperatures, pressure, and loads simulating a space shuttle orbiter flight profile. G.G.

N72-30949# National Bureau of Standards, Washington, D.C.
STANDARD REFERENCE MATERIALS: SELECTION OF DIFFERENTIAL THERMAL ANALYSIS TEMPERATURE STANDARDS THROUGH A COOPERATIVE STUDY (SRM 758, 759, 760)
H. G. McAdie (Ontario Res. Found.), Paul D. Garn (Akron Univ.), and Oscar Menis Aug. 1972 72 p refs
(NBS-SP-260-40; LC-72-600191) Avail: SOD $0.65

The testing and evaluation program leading to the certification of ten materials as Standard Reference Materials of the National Bureau of Standards for calibrating the temperature scale for thermal analysis is described. The results of the analyses are discussed in terms of the restriction imposed on the heating rate. The data were processed to obtain means and measures of scatter, not only in total, but separated in terms of a number of sample holder parameters. The sample holder geometry was the only parameter having clear effect on the extrapolated onset and peak temperatures. Subjects discussed include: (1) properties of materials tested, (2) transition criteria, (3) data processing, and (4) procedures for conducting calibration of temperature scale. Author

N72-30950*# Teledyne Brown Engineering, Huntsville, Ala.
SKYLAB EXPERIMENT PERFORMANCE EVALUATION MANUAL. APPENDIX B: EXPERIMENT M-415, THERMAL CONTROL COATINGS (MSFC)
K. S. Purushotham Aug. 1972 60 p refs
(Contract NAS8-21804)
(NASA-CR-61386-App-B; Rept-5161-App-B) Avail: NTIS HC $5.00 CSCL 20M

Performance tests to determine the thermodynamic properties of thermal control coatings for application to the Skylab corollary

experiments under preflight, inflight, and postflight conditions are described. Malfunction analyses and procedures for working around contingency situations are discussed. The specifications for various sensors and instruments are presented in tables of data. Author

N72-30951*# General Electric Co., Philadelphia, Pa. Reentry and Environmental Systems Div.
EXPLORATORY DEVELOPMENT OF A FLEXIBLE ABLATIVE COVERING FOR SPACE SHUTTLE APPLICATION Final Report
Arnold A. Hiltz Jun. 1972 119 p refs
(Contract NAS9-12067)
(NASA-CR-128502) Avail: NTIS HC $8.00 CSCL 20M

An applied research program is considered for a preliminary design and development of a flexible ablative covering for the space shuttle vehicle that could be easily replaced and/or refurbished. The program was structured to concentrate resources on the major technical problem areas associated with the flexible ablator concept. These areas included: (1) fabrication of a suitable woven carpet reinforcement, (2) modification of a flexible ablator formulation for filling the woven carpet construction, and (3) testing of the flexible ablator concept. Several approaches were evaluated to obtain a flexible ablator. The final recommended solution was one in which the ablative filler was based on a low-density formulation of the elastomeric shield material series (ESM). The preferred approach is one in which a light-weight fabric backing is bonded to preformed and fully cured ESM, and the composite tufted with Astroquartz fiber to the desired tuft or pile density. Ablation tests performed in a hyperthermal arc facility demonstrated the ablation performance of the concept and overshoot capability of the system. Author

N72-30952*# Lockheed Missiles and Space Co., Huntsville, Ala.
A STUDY FOR DEVELOPMENT OF AEROTHERMODYNAMIC TEST MODEL MATERIALS AND FABRICATION TECHNIQUE
W. G. Dean and L. E. Connor Washington NASA Jun. 1972 104 p refs
(Contract NAS1-9983)
(NASA-CR-2065; HREC-9983-1) Avail: NTIS HC $3.00 CSCL 20M

A literature survey, materials reformulation and tailoring, fabrication problems, and materials selection and evaluation for fabricating models to be used with the phase-change technique for obtaining quantitative aerodynamic heat transfer data are presented. The study resulted in the selection of two best materials, stycast 2762 FT, and an alumina ceramic. Characteristics of these materials and detailed fabrication methods are presented. Author

N72-30953*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUMERICAL ANALYSIS OF THE TRANSIENT RESPONSE OF AN AXISYMMETRIC ABLATIVE CHAR LAYER CONSIDERING INTERNAL FLOW EFFECTS
Claud M. Pittman and Lona M. Howser Washington Sep. 1972 62 p refs
(NASA-TN-D-6895; L-7868) Avail: NTIS HC $3.00 CSCL 20M

The differential equations governing the transient response of the char layer of an ablating axisymmetric body, internal pyrolysis gas flow effects being considered, have been derived. These equations have been expanded into finite difference form and programed for numerical solution on a digital computer. Numerical results compare favorably with simplified exact solutions. The complete numerical analysis was used to obtain solutions for two representative body shapes subjected to a typical entry heating environment. Pronounced effects of the lateral flow of pyrolysis gases on the mass flow field within the char layer and the associated surface and pyrolysis interface recession rates are shown. Author

N72-30954*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXAMINATION OF TWO METHODS OF DESCRIBING THE THERMODYNAMIC PROPERTIES OF OXYGEN NEAR THE CRITICAL POINT
Thomas H. Rees and John T. Suttles Washington Sep. 1972 38 p refs
(NASA-TM-X-2590; L-8418) Avail: NTIS HC $3.00 CSCL 20M

A computer study was conducted to compare the numerical behavior of two approaches to describing the thermodynamic properties of oxygen near the critical point. Data on the relative differences between values of specific heats at constant pressure (sub p) density, and isotherm and isochor derivatives of the equation of state are presented for selected supercritical pressures at temperatures in the range 100 to 300 K. The results of a more detailed study of the sub p representations afforded by the two methods are also presented. Author

N72-30955*# Idaho Univ., Moscow. Dept. of Mechanical Engineering.
THE THERMODYNAMIC PROPERTIES OF OXYGEN AND NITROGEN Summary Report
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 31 Aug. 1972 15 p refs
(Contract NAS9-12078)
(NASA-CR-128525) Avail: NTIS HC $3.00 CSCL 20M

The development of a single equation of state for oxygen and nitrogen based on the thermodynamic properties of the gases is described. The coefficients of the equation of state were determined by simultaneous least squares fits to values of isochoric heat capacity and saturation density values used to define the criteria for phase equilibrium. Tables of data for the conditions of both gases are included. Author

N72-30956*# Washington State Univ., Pullman. Program in Engineering Science.
THE THERMODYNAMIC PROPERTIES OF NITROGEN FROM 65 TO 2000 K WITH PRESSURES TO 10,000 ATMOSPHERES Ph.D. Thesis
Richard T. Jacobsen 1972 217 p refs Supported in part by NBS. Office of Std. Reference Data and by Idaho Univ.
(Contract NAS9-12078)
(NASA-CR-128526) Avail: NTIS HC $13.00 CSCL 20M

An equation of state is presented for liquid and gaseous nitrogen for temperatures from 65 degrees K to 2000 degrees K and pressures to 10,000 atmospheres. All the pressure-density-temperature data available from published literature have been corrected and applied to bring experimental temperatures into accord with the International Practical Temperature Scale of 1968. The coefficients of the equation of state were determined by a weighted least squares fit to selected published pressure-density-temperature data. The methods of weighting the various data for simultaneous fitting are presented and discussed. Author

N72-30957*# Idaho Univ., Moscow. Engineering Experiment Station.
THE THERMODYNAMIC PROPERTIES OF OXYGEN AND NITROGEN. PART 1: THERMODYNAMIC PROPERTIES OF NITROGEN FROM 115 R TO 3500 R WITH PRESSURES TO 150000 psia Final Report
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 31 Aug. 1972 231 p refs
(Contract NAS9-12078)
(NASA-CR-128527) Avail: NTIS HC $13.75 CSCL 20M

An equation of state is presented for liquid and gaseous nitrogen for temperatures from 115 R to 3500 R and pressures to 150,000 psia. All of the pressure-density-temperature data available from the published literature have been reviewed, and appropriate corrections have been identified and applied to bring experimental temperatures into accord with the International Practical Temperature Scale of 1968. Comparisons of property

values calculated from the equation of state to measured values are included to illustrate the accuracy of the equation in representing the data. The coefficients of the equation of state were determined by a weighted least squares fit to selected published data and, simultaneously, to constant volume data determined by corresponding states analysis from oxygen data, and to data which define the phase equilibrium criteria for the saturated liquid and saturated vapor. The methods of weighting the various data for simultaneous fitting are presented and discussed. The equation of state is estimated to be accurate to within 0.5 percent in the liquid region, to within 0.1 percent for supercritical isotherms up to 15,000 psia, and to within 0.3 percent from 15,000 to 150,000 psia. Author

N72-30958*# Idaho Univ., Moscow. Coll. of Engineering.
THE THERMODYNAMIC PROPERTIES OF OXYGEN AND NITROGEN. PART 2: THERMODYNAMIC PROPERTIES OF OXYGEN FROM 100 R TO 600 R WITH PRESSURE TO 5000 psia Final Report, period ending 31 Aug. 1972
R. B. Stewart, R. T. Jacobsen, and A. F. Myers 31 Aug. 1972 163 p refs
(Contract NAS9-12078)
(NASA-CR-128528) Avail: NTIS HC $10.25 CSCL 20M

An equation of state is presented for liquid and gaseous oxygen for temperatures from 100 R to 600 R and pressures to 5000 psia. The pressure-density-temperature data available from the published literature have been reviewed, and appropriate corrections have been applied to bring experimental temperatures into accord with the International Practical Temperature Scale of 1968. Representative comparisons of property values calculated from the equation of state to measured values are included to illustrate the accuracy of the equation of state. The coefficients of the equation of state were determined by a weighted least squares fit to selected published data, and simultaneously to isochoric heat capacity data, and to data which define the phase equilibrium for the saturated liquid and saturated vapor. The equation of state is estimated to be accurate for the liquid to within 0.1 percent in density, to within 0.2 percent for the vapor below the critical temperature and for states above the critical temperatures to 250 K, and within 0.1 percent for supercritical states at temperatures from 250 K to 300 K. The vapor pressure equation is accurate to within + or - 0.01 K between the triple point and the critical point. Author

N72-30959*# North American Rockwell Corp., Downey, Calif.
STUDY OF SPRAY DISINTEGRATION IN ACCELERATING FLOW FIELDS Final Report
W. H. Nurick Jun. 1972 101 p refs
(Contract NAS2-6494)
(NASA-CR-114479; R-9017) Avail: NTIS HC $7.25 CSCL 20D

An analytical and experimental investigation was conducted to perform proof of principle experiments to establish the effects of propellant combustion gas velocity on propellant atomization characteristics. The propellants were gaseous oxygen and Shell Wax 270. The fuel was thus the same fluid used in earlier primary cold flow atomization studies using the frozen wax method. Experiments were conducted over a range of 30 to 160 inches at two contraction ratios (2 and 6). Characteristic exhaust velocity efficiencies varied from 50 to 90 percent. The hot fire experimental performance characteristics at a contraction ratio of 6.0 in conjunction with analytical predictions from the droplet heat-up version of the Distributed Energy Release (DER) combustion computer program showed that the apparent initial dropsize compared well with cold flow predictions (if adjusted for the gas velocity effects). The results also compared very well with the trend in performance as predicted with the model. Significant propellant wall impingement at the contraction ratio of 2.0 precluded complete evaluation of the effect of gross changes in combustion gas velocity on spray dropsize. Author

N72-30960# McElroy (Ralph) Co., Austin, Tex.
DETECTION OF STRESS WAVE EMISSION IN A QUASI ROCKET CHAMBER AND CALCULATION OF ITS SOURCE POINTS
Hajime Hatano, Uasunori Yoshida, Ichitaro Sagehashi, and Noboru Niwa [1972] 10 p refs Transl. into ENGLISH of "Giji roketto chemba ni okeru stress wave emission no kenshutsu to sono hasseiten suitei", Tolyo Univ. report AE10-38, Jun. 1971 Sponsored by Dow Chem. Co.
(RFP-Trans-94; AE-10-38) Avail: NTIS

The detection of stress wave emissions in tensile tests of steel, aluminum, and other metal plates was investigated as a method for nondestructive testing. The results indicate: (1) emission occurs at plastic deformation; (2) signals decrease with the beginning of hardening; (3) with forged steel plates, the emission is more noticeable in annealed plates than with untreated plates; and (4) amplitude maxima occur at the arc welded areas of steel plates. It is concluded that stress wave emission is an effective nondestructive test for pressure vessels.
F.O.S.

N72-30961# Oak Ridge National Lab., Tenn.
PROSPECTS FOR FURTHER IMPROVEMENT IN ENHANCED HEAT TRANSFER SURFACES
David G. Thomas 1972 34 p refs Presented at 2d Conf. on Water Desalination, Bhavnagar, India, 1 Mar. 1972 Sponsored by AEC
(Conf-720307-1) Avail: NTIS

The prospects are examined for further improvement in enhanced heat transfer surfaces, specifically surfaces on vertical tubes used for the evaporation and condensation at atmospheric pressure of downward flowing thin films of water. Such heat transfer surfaces are important in desalination facilities. From the point of view of current state-of-the-art of manufacturing capability, double fluted tubes are used as the baseline for comparison. The theoretical bases and experimental data for surface enhancement on both the condensing and evaporating sides are described. It is concluded that the mechanism responsible for high performance on the condensing side of fluted or finned tubes is relatively well understood, at least qualitatively. The mechanism on the evaporating side is apparently much more complicated and not at all well understood.
Author (NSA)

N72-30962# Rome Univ. (Italy). Inst. of Physics.
FREE ENERGY NEAR THE CRITICAL POINT OF FLUIDS ACCORDING TO THE SCALING HYPOTHESIS
E. Lentini and M. Vicentini-Missoni 22 Mar. 1972 46 p refs
(Nota-Interna-364) Avail: NTIS HC $4.50

A phenomenological equation of state which obeys the scaling hypothesis and gives a good representation of data in the critical region of fluids, has been used to calculate the free energy per unit volume. An interpolation formula for the free energy scaled function a(x), which is useful for analytic calculations of thermodynamic functions, is proposed and compared with specific heat and pressure experimental data. Author (ESRO)

N72-30963# Air Force Weapons Lab., Kirtland AFB, N.Mex.
AERODYNAMIC HEATING AND TEMPERATURE DISTRIBUTION PROGRAM FOR ROCKET SLEDS Technical Report, Sep. 1968 - Jan. 1970
William J. Moulds Jan. 1972 68 p refs
(AD-742225; AFWL-TR-70-19) Avail: NTIS CSCL 14/2

A computer program is developed for determining the temperature profile in a rocket sled skin as a function of time or point in the sled trajectory. The program is written in FORTRAN IV for the CDC 6600 computer. The program computes sharp-cone boundary-layer edge conditions, the heat flux, and the time-temperature profile in the skin. The thermal model examined in this report assumes thick-skin solution where the skin is of any composite structure made of discrete layers of material whose properties may vary from layer to layer. A comparison is made between the theoretical predictions and experimental data from three rocket sled tests. The results of this comparison show that the theoretical methods used give excellent correlation with data. Author (GRA)

N72-30964# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
MECHANISM OF MIXING OF TWO NONREACTING GASES
Paul James Ortwerth Oct. 1971 134 p refs
(AF Proj. 3012)
(AD-740909; AFAPL-TR-71-18) Avail: NTIS CSCL 21/5

The turbulence phenomena associated with the mixing of fuel and air in a supersonic combustion ramjet are studied. The turbulence generated by coaxial and normal jet fuel injection is studied by analyzing a control volume in which fuel and air are mixed. These two modes of fuel injection are examined for various initial conditions in order to compare their respective characteristics and determine the design advantages of each mode. Experimental results from a compressible turbulent shear flow experiment, the decay of a supersonic free jet, having important theoretical implications and are used in formulating a new theoretical model for turbulent shear flow. GRA

N72-30965# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF DETONATION PROPAGATION IN NON-STOICHIOMETRIC HYDROGEN-OXYGEN-DILUENT MIXTURES M.S. Thesis
William F. Balmanno Mar. 1972 47 p refs
(AD-741582; GAM/ME/72-4) Avail: NTIS CSCL 21/2

An experimental investigation of the initiation and propagation of shock induced detonation waves in non-stoichiometric hydrogen-oxygen-diluent was conducted. Equivalence ratios of 0.50, 0.75, 1.25, and 1.50 were used with 0, 50 per cent, and 90 percent diluent. Diluents utilized consisted of either argon or helium. The data appeared to verify the finite reaction zone theories of Brinkley and Richardson as well as to give some information concerning critical Mach numbers and detonation onset distances. Author (GRA)

N72-30876* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ASSESSMENT OF RADIATIVE METALLIC THERMAL PROTECTION SYSTEMS FOR SPACE SHUTTLE
Bland A. Stein, Herman L. Bohon, and Donald R. Rummler *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 267-302 (For availability see N72-30865 21-31)
CSCL 20M

N72-30877* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THERMAL PROTECTION SYSTEM TRADE STUDIES ON ABLATORS AND REUSEABLE SURFACE INSULATION
George Strouhal and Donald M. Curry *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 303-334 (For availability see N72-30865 21-31)
CSCL 20M

N72-30878* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OXIDATION PROTECTED CARBON-CARBON
James E. Pavlosky and Leslie G. St Leger *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 335-372 (For availability see N72-30865 21-13)
CSCL 20M

N72-30879* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REUSABLE SURFACE INSULATION MATERIALS RESEARCH AND DEVELOPMENT
Howard E. Goldstein, John D. Buckley, Harry M. King, Hubert B. Probst, and Ivan K. Spiker *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 373-433 (For availability see N72-30865 21-31)
CSCL 20M

N72-30881* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ABLATOR MANUFACTURING
Claud M. Pittman and William D. Brewer *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 475-504 refs (For availability see N72-30865 21-31)
CSCL 20M

N72-30882* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MATERIALS AND DESIGN FOR ABLATIVE HEAT SHIELDS
Marvin B. Dow, Stephen S. Tompkins, and Frank Coe *In its* NASA Space Shuttle Technol. Conf. Jul. 1972 p 505-536 refs (For availability see N72-30865 21-31)
CSCL 20M

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N72-30966*# Ocean Data Systems, Inc., Rockville, Md.
IDENTIFICATION OF SPECIFIC REQUIREMENTS FOR A NASA AEROSPACE LAW INFORMATION SYSTEM AND IDENTIFICATION OF THE ACQUISITION REQUIREMENTS FOR AN AEROSPACE LAW COLLECTION FOR THE NASA LAW LIBRARY
Jerome Morenoff, Donald L. Roth, and James W. Singleton 15 Apr. 1972 168 p refs
(Contract NASw-2266)
(NASA-CR-127836) Avail: NTIS HC $10.50 CSCL 05D

The study to develop, implement, and maintain a space law library and information system is summarized. The survey plan; major interviews with individuals representative of potential sources, users and producers of information related to aerospace law; and system trade-off analyses are discussed along with the NASA/RECON system capability. The NASA publications of STAR and IAA are described, and the NASA legal micro-thesaurus is included. F.O.S.

N72-30967# Committee on Science and Astronautics (U. S. House).
NASA AUTHORIZATION, 1973, PARTS 1, 2, 3, AND 4: INDEX FOR HEARINGS
Washington GPO 1972 189 p refs Hearings on H.R. 12824 (superseded by H.R. 14070) before Comm. on Sci. and Astronaut., 92d Congr., 2nd Sess., 1972
Avail: Comm. on Sci. and Astronaut.

The index of NASA budgetary hearings before the Committee of Science and Astronautics contains personal names, programs, systems, and research projects considered for 1973 funding. G.G.

N72-30968# Committee on Commerce (U. S. Senate).
ENVIRONMENTAL PROTECTION ACT OF 1971, PART 1
Washington GPO 1971 204 p refs Hearings on S. 1032 before the Comm. on Com., 92d Congr., 1st Sess., 15-16 Apr. 1971
Avail: Subcomm. on the Environ.

Hearings are presented for a bill concerning the consideration of ecology and the environment in relation to interstate commerce. K.P.D.

N72-30969# Committee on Commerce (U. S. Senate).
ENVIRONMENTAL PROTECTION ACT OF 1971, PART 2 From the Subcommittee on the Environment

Washington GPO 1971 96 p refs Hearings on S. 1032 before the Comm. on Com., 92d Congr., 1st Sess., 27 Sep. 1971
Avail: SOD $0.40
For abstract. see N72-30968

N72-30970# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT PRELIMINARY REPORT: NORTH CENTRAL AIRLINES, INCORPORATED/AIR WISCONSIN, INCORPORATED CV-580, N90858/DHC-6, N4043B MIDAIR COLLISION NEAR APPLETON, WISCONSIN, 29 JUNE 1972
16 Aug. 1972 7 p
(SA-433) Avail: NTIS HC $3.00

The midair collision of a Convair 580 and a DHC-6 over Lake Winnebago, Wisconsin on 29 June 1972 is reported. The wreckage of both aircraft fell into the lake and all persons involved were fatalities. The report is preliminary in nature pending final decision by the National Transportation safety Board. P.N.F.

N72-30971# RAND Corp., Santa Monica, Calif.
ASPECTS OF LARGE-SCALE RESOURCE SHARING THROUGH NETWORKS OF COMPUTERS
Eric Harslem and John Heafner May 1972 22 p refs
(P-4833) Avail: NTIS HC $3.25

Some advantages of resource sharing through a network of computers as compared to resource sharing through other forms of time sharing services are discussed. The ARPA network of computers is used as an example of large-scale resource sharing in a computer network. The technical and economic aspects of computer networks are described, touching only briefly on legal and social implications. Some difficulties encountered in the use of computer networks and possible ways to address these difficulties are considered. The problem areas are those with application to a broad group of users, and with high potential for solution in the near future. Author

N72-30972# RAND Corp., Santa Monica, Calif.
INCREASING THE EFFECTIVE USE OF ANALYSIS THROUGH PROGRAM-ORIENTED MANAGEMENT
Sue A. Haggart Apr. 1972 12 p refs Presented at Ann. Meeting of the Am. Educational Res. Assoc., Chicago, 3-7 Apr. 1972
(P-4814) Avail: NTIS HC $3.00

Some of the problems analysis has encountered in solving equal educational opportunity situations are discussed. The proposal of a program orientation to the management of school district operations as a means of increasing the effective use of analysis in school district planning is outlined. The meaning of program as used in program-orientation is defined and the rationale for recommending orientation rather than organization is developed. Author

N72-30973# Environmental Protection Agency, Washington, D.C. Office of Noise Abatement and Control.
NOISE PROGRAMS OF PROFESSIONAL/INDUSTRIAL ORGANIZATIONS, UNIVERSITIES AND COLLEGES
31 Dec. 1971 85 p refs
(NTID300.9) Avail: SOD $0.75

Information, pertaining to noise programs being sponsored or carried out, either directly or indirectly, by professional, industrial, and voluntary associations (societies) is provided. Information is also given on private industry research and educational and research programs. A bibliography of pertinent publications relating to noise is included. Author

N72-30974# Environmental Protection Agency, Washington, D.C.
NOISE ABATEMENT AND CONTROL. VOLUME 1: CONSTRUCTION NOISE
9 Jul. 1971 192 p refs Public Hearings before Office of Noise Abatement and Control, Atlanta, 8-9 Jul. 1971
Avail: SOD $0.75

The public hearings on construction noise are reported for Atlanta, Georgia. The statements of 33 witnesses are presented and include discussions on hearing loss, noise control in office buildings, noise in industrial plant construction, and noise control in construction equipment. F.O.S.

N72-30975# Joint Publications Research Service, Arlington, Va.
FIRST CONFERENCE ON OPTIMAL PLANNING AND CONTROL OF THE NATIONAL ECONOMY
15 Aug. 1972 16 p Transl. into ENGLISH from Ekonomika i Mat. Metody (Moscow), no. 3, May - Jun. 1972
(JPRS-56770) Avail: NTIS HC $3.00

Reports presented at the first Soviet conference on optimal planning and control of the national economy are discussed. Systems for automated information gathering and mathematical analysis of data proposed for planning and controlling the economy are included. Author

N72-30976# Committee on Commerce (U. S. Senate).
PUGET SOUND OCEANOGRAPHIC RESOURCES
Washington GPO 1972 171 p Hearing before Comm. on Com., 92d Congr., 2d Sess., 1 Jul. 1971
Avail: Subcomm. on Oceans and Atmosphere

A bill before the subcommittee on oceans and atmosphere on Puget Sound oceanographic resources is presented. The bill is designed to foster a comprehensive long range and coordinated national program in marine science, technology, and resource development of oceanic areas. E.H.W.

N72-30977# Committee on Interior and Insular Affairs (U. S. Senate).
ADVANCED POWER CYCLES
Washington GPO 1972 279 p refs Hearing pursuant to S. Res. 45 before Comm. on Interior and Insular Affairs, 92d Congr., 2d Sess., 8 Feb. 1972
Avail: Comm. on Interior and Insular Affairs

The hearings are reported concerned with new technologies for the environmentally acceptable generation of electricity from coal. The processes for the gasification of coal, and the problem in the removal of sulfur compounds are discussed. Summaries of the EPA activities in compliance with the Clean Air Act are included. F.O.S.

N72-30978# Civil Aeronautics Board, Washington, D.C.
REMARKS BY THE HONORABLE ROBERT T. MURPHY, MEMBER, CIVIL AERONAUTICS BOARD BEFORE THE INTERNATIONAL AVIATION CLUB, WASHINGTON, D. C., 21 MARCH 1972
Robert T. Murphy 21 Mar. 1972 11 p
Avail: NTIS HC $3.00

The problems encountered by the aviation industry in international air transportation service and methods for solving them are discussed. Particular attention was given to charter regulations and illegal charter services. E.H.W.

N72-30979# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN CIVIL AERONAUTICS BOARD BEFORE THE ROYAL AERONAUTICAL SOCIETY, LONDON, UNITED KINGDOM, 13 MARCH 1972
Secor D. Browne 1972 14 p
Avail: NTIS HC $3.00

Nonscheduled transatlantic air services and their problems are discussed. Data cover (1) types of charter and charter rules, (2) uncertainties of flight approval, (3) influence of charter service on regular scheduled service, and (4) charter abuses. E.H.W.

N72-30980# Eurospace, Paris (France).
EUROPE AND SPACE RESEARCH: BALANCE AND PERSPECTIVES [EUROPA UND DIE RAUMFAHRT BILANZ UND PERSPEKTIVEN]
1972 48 p In GERMAN
Avail: NTIS HC $4.50

Some questions concerning the role of European aerospace industry in futher development of European space programs are discussed in general. A state-of-the-art of space programs is presented, and motivations are given for space missions. The importance of astronautics for the human race in the course of the coming decades, and the results of Europe not participating, are discussed. Possibilities and limits of European participation, common policy, and the areas of cooperation are investigated.
ESRO

N72-30981# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[AEROSPACE ACTIVITIES] Annual report, 1971
1972 177 p In FRENCH
Avail: NTIS HC $11.00

Activities carried out during 1971 in the systems, aerodynamics, wind tunnel structures, energetics, physics, materials, and computer departments of ONERA are briefly described. A list is given of ONERA patents applied for during 1971.
ESRO

N72-30982# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
AN INTRODUCTION TO SYSTEM COST MODELLING
A. T. Boyd May 1972 50 p refs
(ETN-6) Avail: NTIS HC $4.50

Techniques useful in deriving cost estimates and in checking the completeness of the cost model are described. Typical problems arising during basic definition are illustrated with the aid of a military example. Advantages to be gained by the use of a computerized cost model are outlined. The essential role of cost models within cost effectiveness analyzed is explained, together with methods of examining the way in which system costs are affected by changes in the system composition. ESRO

N72-30983# System Sciences, Inc., Bethesda, Md.
DEVELOPMENT OF A SHELTER BLAST AND FIRE VULNERABILITY DATA SYSTEM Final Report
H. J. Avise Nov. 1971 101 p refs
(Contract DAHC20-70-C-0385)
(AD-740805; SYSSCI-71-17) Avail: NTIS CSCL 13/13

The study investigates the data and methods required for developing a Shelter Blast and Fire Vulnerability Data System. The objective is to develop an inexpensive method of determining the blast and fire vulnerability of fallout shelters by using available building data and existing vulnerability models. Numerous sources of structural data are examined including computerized listings of specifications of fallout shelter facilities, various types of maps, and aerial photography. A methodology is developed and procedures are specified for converting the data available in these source documents to suitable indicators of blast and fire vulnerability.
Author (GRA)

N72-30984# Office of Naval Research, London (England).
SCIENCE, MAN AND ENVIRONMENT
Edward I. Salkovitz 13 Mar. 1972 27 p Presented at 4th Intern. Sci. and Soc. Conf., Herceg-Novi, Yugoslavia, Jul. 1971
(AD-740759; ONRL-C-6-72) Avail: NTIS CSCL 06/6

At the Fourth International Science and Society Conference, which was held in Herceg-Novi, Yugoslavia in July 1971, the major theme was: Science, Man and His Environment. After a series of papers which served to delineate the fields for discussion, attention was turned to problems relating economic and technical development to the environment, then the role of man within the environment. Papers followed on urban planning, control of resources, education, information and legislation. GRA

N72-30985# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
MODEL BEHAVIOR OF A RESOURCE ALLOCATION SYSTEM IN A GOVERNMENT RESEARCH AND DEVELOPMENT LABORATORY
Wilbur Gene James Jan. 1972 87 p refs
(AD-740432; AFFDL-TR-71-72) Avail: NTIS CSCL 05/1

The investigation was conducted to evaluate the model behavior of a resource allocation system in a government research and development laboratory. Resource allocation is concerned with both project selection and rate of progress control (by regulation of the amount of resources applied to each project). The decision process used by the Air Force Flight Dynamics Laboratory (AFFDL) is modeled to show the present and possible future interrelationships between human factors and computer calculations. A method is described for objectively evaluating the transfer function or model behavior of the computerized poriton of this overall decision process with respect ot futurity, timing, risk, uncertainty, payoff values other than profits, and image. These behavior characteristics were determined for the AFFDL based on an evaluation of historical data.
Author (GRA)

N72-30986# Cubic Corp., San Diego, Calif.
ACMR SYSTEM SIMULATION. VOLUME 1: SIMULATION PROGRAM DESCRIPTION Final Technical Report
20 Dec. 1971 563 p refs 2 Vol.
(Contract N00019-71-C-0429)
(AD-741194; FTR/525-1-Vol-1) Avail: NTIS CSCL 15/7

The two-volume document comprises the final technical report on the ACMR (Air Combat Maneuvering Range) System Simulation, and is submitted in compliance with Attachment 5, Contract N00019-71-C-0429. Volume 1 provides general, technical, and physical descriptions of the system simulation program, and Volume 2 consists primarily of computer output representing the results of the simulation. The simulation program described in this report has been developed to aid in the system performance analysis of the Air Combat Maneuvering Range tracking and display hardware which is presently undergoing development.
Author (GRA)

N72-30987# Cubic Corp., San Diego, Calif.
ACMR SYSTEM SIMULATION. VOLUME 2: SIMULATION TEST RESULTS Final Technical Report
7 Mar. 1972 546 p 2 Vol.
(Contract N00019-71-C-0429)
(AD-741195; FTR/525-1-Vol-2) Avail: NTIS CSCL 15/7

The purpose of this volume, the second in the ACMR system simulation series, is to document the quantitative results of the ACMR System Simulation, as introduced and described in Volume I of this report. The results presented herein represent the entire ACMR instrumentation system as defined by the AIS, TIS, and CCS subsystems.
Author (GRA)

N72-30988# Stanford Research Inst., Menlo Park, Calif. Naval Warfare Research Center.
DOCUMENTATION FOR THE NWRC/AAWG-71-AAW SIMULATION MODEL
O. F. Forsyth and J. J. Penick Jul. 1971 331 p
(Contract N00014-71-C-0119; NR Proj. 274-008; SRI Proj. 1016-225)
(AD-740343) Avail: NTIS CSCL 15/3

The report constitutes the documentation for a large scale antiair warfare computer simulation model designated the NWRC/AAWG-71. The model is, to the greatest extent practicable, machine and installaton independent. It has the capability of handling up to 31 defense units (ships and AEW aircraft) and up to 255 offense units (launch vehicles, stand-off jammers, cruise missiles, etc.). There are numerous potential applications of the model. Task force runs may be made to establish the relative effectiveness of the defense when changes are introduced in ship configurations (alternate radars or weapon systems) or in ship dispositions. Similarly, the effects of changes in enemy attack tactics (raid size, weapon types, flight profiles, jamming levels, or target selection) may be assessed.
Author (GRA)

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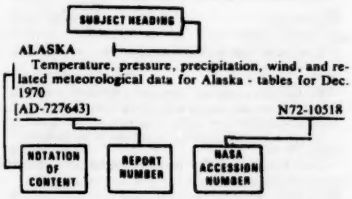

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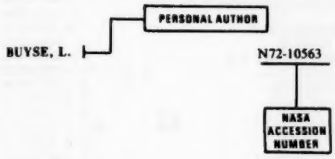

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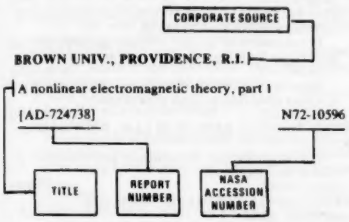

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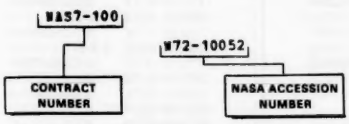

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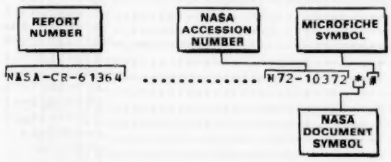

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AD-742377 ..... N72-30673 #
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AD-742468 ..... N72-30072 #

AE-10-38 ..... N72-30960 #

AEDC-TR-71-264 ..... N72-30418 #
AEDC-TR-72-32 ..... N72-30295 #
AEDC-TR-72-54 ..... N72-30258 #

AER-12-F ..... N72-30343*#

AERE-BIB-176 ..... N72-30637 #

AFAPL-TR-71-18 ..... N72-30964 #
AFAPL-TR-71-42 ..... N72-30049 #
AFAPL-TR-72-19 ..... N72-30041 #

AFATL-TR-71-67 ..... N72-30290 #
AFATL-TR-71-149 ..... N72-29997 #

AFCRL-AFSIG-237 ..... N72-30795 #

AFCRL-ERP-375 ..... N72-30376 #
AFCRL-ERP-384 ..... N72-30181 #
AFCRL-ERP-387 ..... N72-30377 #

AFCRL-PSRP-474 ..... N72-30187 #
AFCRL-PSRP-477 ..... N72-30753 #
AFCRL-PSRP-478 ..... N72-30215 #

AFCRL-SR-133 ..... N72-30078 #

AFCRL-TRANS-95 ..... N72-30796 #

AFCRL-71-0049-1 ..... N72-30845 #
AFCRL-71-0574 ..... N72-30376 #
AFCRL-71-0581 ..... N72-30580 #
AFCRL-71-0605 ..... N72-30796 #
AFCRL-72-0004 ..... N72-30369 #
AFCRL-72-0018 ..... N72-30372 #
AFCRL-72-0045 ..... N72-30050 #
AFCRL-72-0047 ..... N72-30187 #
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AFCRL-72-0179 ..... N72-30161 #
AFCRL-72-0207 ..... N72-30385 #

AFFDL-TR-71-37 ..... N72-30019 #
AFFDL-TR-71-64 ..... N72-30909*#
AFFDL-TR-71-72 ..... N72-30985 #
AFFDL-TR-71-170 ..... N72-30025 #
AFFDL-TR-72-25 ..... N72-30016 #

AFHRL-TR-71-52 ..... N72-30120 #

AFML-TR-71-51 ..... N72-30480 #
AFML-TR-71-161 ..... N72-30517 #
AFML-TR-71-204 ..... N72-30523 #
AFML-TR-71-231 ..... N72-30511 #
AFML-TR-72-29 ..... N72-30487 #

AFOSR-71-2436TR ..... N72-30939 #
AFOSR-71-2992TR ..... N72-30930 #
AFOSR-71-3028TR ..... N72-30771 #
AFOSR-71-3087TR ..... N72-30027 #
AFOSR-72-0251TR ..... N72-30286 #
AFOSR-72-0321TR ..... N72-30521 #
AFOSR-72-0364TR ..... N72-30233*#
AFOSR-72-0409TR ..... N72-30493 #
AFOSR-72-0539TR ..... N72-30202*#
AFOSR-72-0614TR ..... N72-30764 #
AFOSR-72-0730TR ..... N72-30759 #
AFOSR-72-0741TR ..... N72-30080 #
AFOSR-72-0767TR ..... N72-30675 #
AFOSR-72-0816TR ..... N72-30676 #
AFOSR-72-0848TR ..... N72-30081 #
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AFOSR-72-0865TR ..... N72-30169 #
AFOSR-72-0902TR ..... N72-30238 #
AFOSR-72-0920TR ..... N72-30545 #
AFOSR-72-0936TR ..... N72-30758 #
AFOSR-72-1005TR ..... N72-30297 #
AFOSR-72-1010TR ..... N72-30936 #
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AFOSR-72-1032TR ..... N72-30017 #
AFOSR-72-1039TR ..... N72-30674 #
AFOSR-72-1040TR ..... N72-30672 #
AFOSR-72-1045TR ..... N72-30159 #
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AFOSR-72-1102TR ..... N72-30165 #
AFOSR-72-1103TR ..... N72-30164 #
AFOSR-72-1106TR ..... N72-30166 #
AFOSR-72-1113TR ..... N72-30212 #
AFOSR-72-1115TR ..... N72-30162 #
AFOSR-72-1153TR ..... N72-30288 #
AFOSR-72-1158TR ..... N72-30285 #
AFOSR-72-1159TR ..... N72-30284 #

AFRPL-TR-72-33 ..... N72-30417 #

AFWL-TR-70-19 ..... N72-30963 #
AFWL-TR-71-94 ..... N72-30022 #
AFWL-TR-71-106 ..... N72-30209 #
AFWL-TR-71-122 ..... N72-30208 #
AFWL-TR-71-164 ..... N72-30792 #
AFWL-TR-71-179 ..... N72-30647 #

AI-72-7 ..... N72-30047 #

AMMRC-TR-71-38 ..... N72-30492 #
AMMRC-TR-72-11 ..... N72-30414 #

AMRL-TR-71-29-PAPER-1 ..... N72-30084 #
AMRL-TR-71-29-PAPER-3 ..... N72-30086 #
AMRL-TR-71-29-PAPER-4 ..... N72-30087 #
AMRL-TR-71-29-PAPER-5 ..... N72-30088 #
AMRL-TR-71-29-PAPER-6 ..... N72-30089 #
AMRL-TR-71-29-PAPER-7 ..... N72-30090 #
AMRL-TR-71-29-PAPER-11 ..... N72-30091 #
AMRL-TR-71-29-PAPER-12 ..... N72-30092 #
AMRL-TR-71-29-PAPER-13 ..... N72-30093 #
AMRL-TR-71-29-PAPER-14 ..... N72-30094 #
AMRL-TR-71-29-PAPER-15 ..... N72-30095 #
AMRL-TR-71-29-PAPER-16 ..... N72-30096 #
AMRL-TR-71-29-PAPER-17 ..... N72-30097 #
AMRL-TR-71-29-PAPER-18 ..... N72-30076 #
AMRL-TR-71-29-PAPER-19 ..... N72-30075 #
AMRL-TR-71-29-PAPER-20 ..... N72-30074 #
AMRL-TR-71-29-PAPER-22 ..... N72-30098 #
AMRL-TR-71-29-PAPER-23 ..... N72-30085 #
AMRL-TR-71-29-PAPER-24 ..... N72-30099 #
AMRL-TR-71-29-PAPER-25 ..... N72-30100 #
AMRL-TR-71-29-PAPER-26 ..... N72-30101 #
AMRL-TR-71-29-PAPER-27 ..... N72-30102 #

AMRL-TR-71-29-PAPER-28 ..... N72-30103 #
AMRL-TR-71-29-PAPER-29 ..... N72-30104 #
AMRL-TR-71-29-PAPER-33 ..... N72-30105 #
AMRL-TR-71-29-PAPER-34 ..... N72-30106 #
AMRL-TR-71-29-PAPER-35 ..... N72-30107 #
AMRL-TR-71-29-PAPER-36 ..... N72-30108 #
AMRL-TR-71-29-PAPER-37 ..... N72-30109 #
AMRL-TR-71-29-PAPER-38 ..... N72-30110 #
AMRL-TR-71-76 ..... N72-30172 #
AMRL-TR-71-119 ..... N72-30122 #

AMRL-1040 ..... N72-30585*#

ANT-LAB-72-6-1 ..... N72-30947*#

APL-CLB-3-T-647 ..... N72-30852 #
APL-CLB-3-T-649 ..... N72-30595 #

APL-TG-1184 ..... N72-30597 #

APP-31 ..... N72-30620*#
APP-35 ..... N72-30129*#

AR-1 ..... N72-30440 #
AR-3 ..... N72-30077 #
AR-10 ..... N72-30518 #

ARC-TR-2 ..... N72-29992 #

ARDG(E)-E-1262 ..... N72-30755 #

ARL-71-0303 ..... N72-30302 #
ARL-71-0317 ..... N72-30678 #
ARL-72-0011 ..... N72-30289 #
ARL-72-0016 ..... N72-30494 #
ARL-72-0018 ..... N72-30136 #
ARL-72-0023 ..... N72-30283 #
ARL-72-0034 ..... N72-30793 #

ASPR-4 ..... N72-30164 #

ATC-13 ..... N72-30587 #

AVSD-0076-72-RR ..... N72-30248*#
AVSD-0390-71-CR ..... N72-30678 #

AWRE-O-5-72 ..... N72-30477 #

BDX-613-614 ..... N72-30744 #

BM-IC-8551 ..... N72-30123 #

BM-2995-F-1 ..... N72-30909*#

BMI-1921 ..... N72-30924 #

BNL-16616 ..... N72-30253 #

BNWL-1308-9 ..... N72-30635 #

BRL-MR-2178 ..... N72-30419 #

BR23438 ..... N72-30770 #
BR23439 ..... N72-30506 #
BR27442 ..... N72-30363 #
BR28516 ..... N72-30507 #

C/PLSEL-TS-182 ..... N72-30522 #

CAL-A1-3108-A-1 ..... N72-30261*#

CAM-100-15 ..... N72-30933 #

CASUC-MLML-TP-72-04-PT-1 ..... N72-30340 #

CEA-R-4290 ..... N72-30789 #

CERL-TR-M-14 ..... N72-30257 #

CHR-71-17 ..... N72-30518 #
CHR-72-4 ..... N72-30760 #

CHU-031-727-4 ..... N72-30481 #

COMMUN-26 ..... N72-30839 #

CONF-700977-1 ..... N72-30633 #
CONF-710540-1 ..... N72-30357 #
CONF-710926-2 ..... N72-30406 #

CONF-711016-10 ..... N72-30658 #
CONF-720112-1 ..... N72-30602 #
CONF-720306-2 ..... N72-30746 #
CONF-720307-1 ..... N72-30961 #

CONTRIB-29 ..... N72-30340 #
CONTRIB-1879 ..... N72-30725
CONTRIB-3126 ..... N72-30684
CONTRIB-3127 ..... N72-30729

COO-1799-9 ..... N72-30134 #
COO-3421-2 ..... N72-30657 #

CPT-115 ..... N72-30629 #

CR-150 ..... N72-30425*#

CSR-T-72-2 ..... N72-30864*#

CSSE-734 ..... N72-30159 #
CSSE-735-REV ..... N72-30543 #

D-MAT-179 ..... N72-30015 #

D-131 ..... N72-30840 #
D-132 ..... N72-30841 #
D-133 ..... N72-30365 #
D-139 ..... N72-30842 #
D-142 ..... N72-30843 #
D-143 ..... N72-30669 #

DDC-TAS-72-16-1 ..... N72-30026 #
DDC-TAS-72-19-1 ..... N72-30441 #
DDC-TAS-72-21-I ..... N72-30436 #

DGS-167 ..... N72-30369 #

DIN-72SD4223-VOL-1-BK-1 ..... N72-30038*#
DIN-72SD4223-VOL-1-BK-2 ..... N72-30039*#

DLR-FB-72-28 ..... N72-30236 #
DLR-FB-72-30 ..... N72-30609 #
DLR-FB-72-32 ..... N72-30281 #
DLR-FB-72-36 ..... N72-30671 #
DLR-FB-72-37 ..... N72-30928 #

DLR-MITT-72-13 ..... N72-30237 #

DMI-GEOPHYS-PAPERS-R-27 ..... N72-30360 #
DMI-GEOPHYS-PAPERS-R-31 ..... N72-30359 #

DMS-DR-1207-VOL-1-REV ..... N72-30908*#

DNA-2825F ..... N72-30374 #
DNA-2845F ..... N72-30929 #

DOC-72SD4233 ..... N72-30033*#

DOT-OS-10075 ..... N72-30018 #

DPD-239 ..... N72-30861*#
DPD-261-DR-MA04-VOL-1 ..... N72-30216*#
DPD-261-DR-MA04-VOL-3 ..... N72-30217*#

DR-700 ..... N72-30582 #

DSPS-72-1 ..... N72-30525 #

D180-15048-1-VOL-2 ..... N72-30897*#
D272-099-002 ..... N72-30013*#
D7425-953C04-VOL-1 ..... N72-30216*#
D7425-953004-VOL-3 ..... N72-30217*#

E-1483 ..... N72-30756 #
E-2618 ..... N72-30583*#
E-6519 ..... N72-30189*#
E-6682 ..... N72-30428*#
E-6844 ..... N72-30607*#
E-6896 ..... N72-30740*#
E-6911 ..... N72-30503*#
E-6913 ..... N72-30778*#
E-6920 ..... N72-29993*#
E-6929 ..... N72-30127*#
E-6949 ..... N72-30427*#
E-6962 ..... N72-30601*#
E-6974 ..... N72-30429*#
E-6977 ..... N72-30777*#
E-6986 ..... N72-30268*#
E-6992 ..... N72-30269*#

E-6996 ..... N72-30036*#
E-7016 ..... N72-30247*#
E-7020 ..... N72-30471*#
E-7053 ..... N72-30776*#
E-7086 ..... N72-30775*#

ECOM-0084-4 ..... N72-30591 #
ECOM-0268-4 ..... N72-30205 #
ECOM-0336-1 ..... N72-30752 #
ECOM-3534 ..... N72-30171 #
ECOM-3553 ..... N72-30051 #
ECOM-3558 ..... N72-30052 #
ECOM-5422 ..... N72-30387 #

EGG-1183-1522 ..... N72-30357 #

EM-72-2 ..... N72-30437 #

ERDE-TR-40 ..... N72-30506 #
ERDE-TR-45 ..... N72-30770 #
ERDE-TR-53 ..... N72-30508 #
ERDE-TR-54 ..... N72-30509 #
ERDE-TR-68-PT-4 ..... N72-30507 #

ERI-72072 ..... N72-30547 #

ESD-TR-71-387 ..... N72-30193 #
ESD-TR-72-81 ..... N72-30751 #
ESD-TR-72-132 ..... N72-30163 #
ESD-TR-72-142 ..... N72-30168 #

ESL-R-480 ..... N72-30218*#

ESRO-CR(P)-112 ..... N72-30155 #
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Because of its work with turbine systems, Lewis Research Center presented a course on "Turbine Design and Application" during 1968–1969 as part of its in-house graduate study program. The course material covered thermodynamic and fluid-dynamic concepts, fundamental turbine concepts, velocity diagrams, losses, blade aerodynamic design, mechanical design, operation, performance, and requirements and problems associated with various applications. Much of the material referred primarily to axial-flow turbines, with radial-inflow turbines covered as a specific topic. This volume presents the material covered in the first six lectures. Two more volumes will follow as soon as the lecture notes are revised and edited for publication. *Paperbound.* 108 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $0.60.

Space Simulation (NASA SP–298)

This volume contains the conference papers of the sixth Space Simulation symposium, sponsored by the Institute of Environmental Sciences, the American Institute of Aeronautics and Astronautics, the American Society for Testing and Materials, and Goddard Space Flight Center, held May 1–3, 1972, in New York City. *Paperbound.* 1096 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $4.50.

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